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Health-Related Behavioral Impact of
the Three Mile Island Nuclear Incident

Report Submitted to the TMI Advisory Panel
On Health Research Studies
of
The Pennsylvania Department of Health

PART I

by

*Peter S. Houts, Ph.D., Principle Investigator

*Robert W. Miller, Ph.D.

**George K. Tokuhata, Dr. P.H., Ph.D.

**Kum Shik Ham, Ph.D.

*The Pennsylvania State University, College of Medicine

and

**The Pennsylvania Department of Health

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CHAPTER I

INTRODUCTION

The "nuclear incident" at Three Mile Island (TMI) nuclear power plant beginning on March 28, 1979, resulted in widespread fear of danger to the surrounding population and the temporary exodus of a substantial portion of the population in the vicinity of the facility. Since the event there has been continuous publicity about the situation at the crippled reactor with the result that, what began as a brief crisis, has become a continuous and, for some, a chronically disturbing situation.

The purpose of this report is to describe how persons living in the vicinity of TMI reacted during the crisis, as well as 3 and 9 months later. Data to be presented are drawn from three sources: 1) telephone surveys of persons in the area of TMI funded under contracts of the Pennsylvania Department of Health 2) a similar set of telephone interviews sponsored by the Nuclear Regulatory Commission 3) interviews with patients at the Hershey Medical Center concerning their experiences during the crisis.

The material included here is part one of the total report, and will focus on: 1) characteristics of the population residing in the area of TMI, 2) description of the evacuation decisions and behavior during the crisis period and 3) the extent, severity, and duration of distress experienced by persons living in the vicinity of TMI.

Additional topics, to be submitted later, include the role of coping strategies and social support in mediating stress, the impact of the crisis on the health delivery system and, finally, recommendations for public policy that can be drawn from the previous analyses.

Acknowledgements

Many people have contributed to the findings to be reported here. The authors wish to acknowledge the following persons who have been particularly helpful.

Dr. Cynthia Bullock Flynn of Social Impact Research Inc. and Mr. Michael Kaltman of the Nuclear Regulatory Commission (NRC) were very helpful to the work reported here. In planning the Nuclear Regulatory Commission's TMI telephone survey, they shared their draft questionnaires with us as we did with them. As a result, many of the questions included in the two surveys are the same. This permits cross comparisons and allows the two studies to complement each other, extending the total knowledge beyond what either study could have contributed alone. Dr. Flynn and Mr. Kaltman have also been generous in allowing access to their raw data and, as a result, many analyses reported here involve data from both surveys.

Faculty and patients of the Department of Family and Community Medicine and Pediatrics of the M.S. Hershey Medical Center played an important role in this work. Many of the NRC and Penn State survey items were based on interviews and questionnaire data obtained immediately after the crisis from both patients and staff in those departments. Joseph Leaser, M.D. of Middletown and his patients also generously contributed their time and ideas to this work. Mr. Joseph Dixon was very helpful in carrying out computer analyses and Dr. Robert Munzenrider assisted us in gaining access to NRC data files. Ms. Ellin Hufford assisted in interviews, data collection and analysis.

We are indebted to a number of social scientists who served as formal and informal consultants to this project. Their professional experience and expertise was an invaluable aid in study design, questionnaire construction, data analysis and interpretation. While they are not responsible for conclusions drawn here they have contributed substantially to this effort. We wish to especially acknowledge the assistance of Dr. Morton Kramer, Dr. Elmer Streuning, Dr. David Mechanic, Mr. Paul Cleary, Dr. Evan Pattishall, and Dr. Carl Thompson. We have also been helped by discussions with Dr. Bruce Dohrenwend about how the findings of this study relate to conclusions of the Task Force on Behavioral Effects of the President's Commission on the Accident at Three Mile Island. Dr. Teh Hu, who directed the study of the economic impact of the Three Mile Island crisis collaborated with us in this work. Data for his project was collected in the same surveys as used for this report. Dr. Hu has also been a very helpful consultant in data analysis aspects of this work.

We would like to acknowledge the technical help of the staff of Chilton Research Services, which conducted the telephone surveys reported here. Ms. Nancy Kreuser and Ms. Carol DeGennaro contributed to questionnaire design as well as to the efficient, professional manner in which data collection was carried out.

A sub committee of the TMI Advisory Panel on Health Research Studies was responsible for overseeing this work. Dr. Calvin Fredricks, Dr. Morton Kramer and Dr. Evan Pattishall provided guidance and important support in obtaining resources necessary for this project.

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CHAPTER 2

METHODOLOGY

Findings to be reported here come from three sources: 1) a telephone survey in July, 1979 of 692 persons living within 5 miles of Three Mile Island, (July Penn State survey), 2) a telephone survey in July, 1979 of 1506 persons living within 55 miles of Three Mile Island (July NRC survey) and 3) a telephone survey in January, 1980 which repeats elements of both of the July surveys (January Penn State survey). The January survey included re-interviews with 404 persons from the Penn State July survey plus 550 persons selected so as to replicate the July NRC study. Description of the content and method of each survey follows.

Penn State July Survey

Content: Questions included in this survey were, in part, based on interviews and questionnaires obtained from patients at the Hershey Medical Center and in the practice of Dr. Joseph Leaser in Middletown just after the crisis in April and May, 1979. Questions about stress-related symptoms, reasons for staying or leaving and coping strategies were drawn from this earlier work. In addition, questions were included concerning utilization of health services, use of alcohol, tobacco and tranquilizers, ethnic background, religious activity, social support and marital status. A number of questions concerning economic costs of the crisis were also included and have been analyzed and reported by Dr. Hu.

Data collection: Telephone interviews were conducted from July 12 to July 26, 1979 by Chilton Research Services, a professional interviewing organization in Radnor, Pennsylvania. Random digit dialing was used for all exchanges within the 5 mile radius. The random digit method assures access to all households with phones, both listed as well as unlisted. Interviewers first established whether

it was a home (rather than a business) phone, and whether the home was within 5 miles of Three Mile Island. If these questions were affirmative, they asked to speak to the male head of the household. If the male head was not present, they asked for the female head of household.* Numbers with no answer were called up to four times and refusals were recalled once. Before beginning the interview, an informed consent statement was read as follows:

Good _____ I'm _____ calling from Chilton Research in Radnor, Pennsylvania. We are conducting a study for the Penn State University Medical School and the Pennsylvania Department of Health among residents in your area on the effects of the Three Mile Island incident.

Your participation in this survey is voluntary. Any information which you give us in response to our questions will be kept strictly confidential and will be used only for routine statistical research purposes.

At the end of each interview, each respondent was asked if he or she would agree to be interviewed again at some later date. If the interviewee said yes, his or her name, address and telephone number were recorded. If the interviewee refused, no identifying information was recorded.

Interviews were monitored by supervisory staff at Chilton throughout the survey to insure correct administration of the questionnaire and accurate recording of responses. Completed questionnaires were later checked for completeness and consistency by editors. Questionnaires which did not pass editing were returned to the interviewers for call backs and clarification.

A response rate of 75% was achieved. That is, it is estimated that 75% of households within the 5 mile radius of Three Mile Island which fell into the sample yielded a completed interview. The 25%, non-response is divided into an

*Male head of household was requested first in order to increase the number of male respondents which would normally be under-represented if male or female were requested equally.

estimated 11% refusal rate and an estimated 14% no answer or eligible respondent not available. In addition, it should be noted that 582 or 81% of respondents agreed to be re-interviewed at some future date.

NRC July Survey

A detailed description of how the NRC survey was designed and carried out is available in Three Mile Island Telephone Survey, Preliminary Report of Procedures and Findings A report to the U.S. Nuclear Regulatory Commission by Cynthia Bullock Flynn, September, 1979. A few general comments will be made here. The NRC survey was carried out from July 23 to August 7, 1979 and used the same interviewing organization (Chilton Research Services) as was used for the Penn State study. Approximately 40% of the questions were identical to those in the Penn State study including reasons for leaving or staying, stress-related symptoms, and economic impact of the crisis. Areas which were included in the NRC, but not in the Penn State studies were attitudes toward nuclear power and attitudes toward how the crisis was handled by local, state and federal authorities. Areas unique to the Penn State study included coping strategies, social support and use of health delivery systems. One thousand five hundred and four interviews were completed. Respondents were located from less than 1 to approximately 55 miles from the Three Mile Island facility. Respondents were grouped by distance and direction from the plant. Sampling methods, monitoring and editing procedures were essentially the same as in the Penn State study. Refusal and response rates were also similar in the two studies.

Penn State January Survey

Content: Four types of questions were included in the January follow-up survey: 1) stress-related symptoms and feelings about the situation at Three Mile Island repeated from the July surveys 2) utilization of health delivery system since the April crisis and related economic costs, 3) questions concerning

mental status which, in other research, have been shown to relate to symptom reporting and health care utilization and 4) additional questions concerning the degree of social support available to respondents. Two very similar questionnaires were developed; one to re-interview 404 persons selected randomly from the 582 persons who had agreed to be re-interviewed from the July Penn State study and the second to interview 550 persons who live from 0-55 miles from Three Mile Island and selected in the same manner as in the original NRC survey. Differences between the two questionnaires are largely in demographic information that had to be collected for the 0-55 mile sample, but which had been collected earlier for the 404 re-interview subjects.

Data Collection: Telephone interviews were conducted by Chilton Research Services from January 17 to February 9, 1980, using the same procedures described above. A response rate of 82% and a refusal rate of 11% was achieved for the 0-55 mile sample. Of the 468 subjects approached for re-interview, 9 refused re-interviews, 46 had disconnected phones and had probably moved while 9 did not answer phones on 4 calls.

CHAPTER 3

DESCRIPTION OF THE POPULATION SURVEYED IN THE IMMEDIATE VICINITY OF THREE MILE ISLAND

The objectives of this chapter are: 1) to describe the demographic and other characteristics of the population included in the Penn State July survey within 5 miles of Three Mile Island (PSU survey) and 2) to compare these population characteristics with those of the nation as a whole. This comparison will help in establishing the generalizability of our findings to other locations. It should be noted that the PSU survey of 692 persons within 5 miles of TMI, which is the focus of this chapter, utilized random digit dialing which insured access to all phones in the area, listed as well as unlisted. As explained in chapter 2, a 75% response rate was achieved, with an estimated 11% refusal rate.

DEMOGRAPHIC CHARACTERISTICS

As is indicated in Table 3.1, demographic characteristics of the PSU sample are quite similar to those of the US population. The PSU sample is close to the national norm for average age of heads of households, proportion of males, proportion of the population with a Hispanic background and proportion who are widowed, separated or divorced. However, it differs strikingly in the proportion of the population which is black, (1.0%, versus a national figure of 10.2%), single (10.9%, versus 26.6%), married (73.6%, versus 59.2%) and in the mean family size (3.1 versus 2.87). The differences in % single and married between the PSU sample and national norms are due, at least in part, to different sampling methods and not necessarily to actual population differences. The census

data includes all persons over 14 years of age in assigning marital status categories while the PSU survey included only male and female heads of households in the sample. Therefore, single persons living with parents would be part of the census counts, but would not be present in the PSU sample. The large (42%) who consider themselves "Pennsylvania Dutch" is a unique feature of this population. It should be noted that Amish or Mennonites, who are sometimes identified with the term "Pennsylvania Dutch" are, at most, a small part of this group. While there is no data on whether respondents were Amish or Mennonites (though no Amish would be represented since they have no phones) these groups constitute a small percentage of the persons who consider themselves "Pennsylvania Dutch."

Differences between the PSU sample and national norms are somewhat greater when one looks at education, occupation income and religious affiliation (table 3.2). Here, the study population is somewhat better educated (74.3% have completed high school, compared to 68.0% for the US population), more likely to have a total family income greater than \$10,000, (80% versus 72.6%), but markedly more likely to be employed in a blue-collar occupation (69.0% versus 33.9%). This predominance of blue collar workers may be due to the presence of a steel mill and other manufacturing facilities in the vicinity. The criteria for classification into blue or white collar also differed slightly between this study and the census. Therefore, category definitions may also play a role in these differences. Patterns of religious affiliation were generally similar to the entire population, with the exception of an underrepresentation of Jews and those listing their affiliation as "none" or "other." The percent attending church at least weekly is exactly equal to the national norms.

TABLE 3.1
 DEMOGRAPHIC CHARACTERISTICS - I
 AGE, SEX, RACE, MARITAL STATUS AND FAMILY SIZE

	PSU SURVEY	NATIONAL * NORMS
Mean age, head of household	42.4	45.7 **
% Male (respondents)	52.1	46.8 ***
% Black	1.0	10.2
% Hispanic	4.0	4.7
% Widowed, separated or divorced	15.5	14.2
% Single	10.9	26.6
Mean family size	3.1	2.87

It should also be noted that 42% of this sample identified themselves as "Pennsylvania Dutch," by which is meant descendents of German and Swiss immigrants who settled in the area in the 18th and early 19th centuries.

*"National norms" calculated from latest available census data. Since question format and categories were rarely precisely equivalent, all normative data must be regarded as approximations.

**estimated from group data

***North Eastern United States

OTHER CHARACTERISTICS

Mobility and Home Ownership

Table 3.3 shows the length of residence in area. The most comparable national data are that, in 1978, 85% of the U.S. population had lived in the same county for at least 3 years. An examination of the PSU data shows that length of residence of persons in the sample is approximately the same as those national norms. However, the proportion of the population who own their homes is almost 14% higher than the national average.

Health-Related Characteristics

The PSU study population shows some minor differences in various health-related activities compared to national norms. (See table 3.4) Our respondents were somewhat less likely to use sleeping pills than the national norms, but are more likely to be smokers. The proportion of the population consuming alcoholic beverages at least several times a week is almost identical with the national norm.

SUMMARY

It would appear, on the basis of a limited comparison with the US population as a whole, that the population surveyed in the PSU study is not strikingly deviant from national norms. There are differences in areas such as ethnic composition, education levels, and family and occupational structure, home ownership, sleeping pill use and percent of smokers. However, the sample population was very close to national norms in age of heads of households, church attendance, length of residence in area, and alcohol consumption.

TABLE 3.2

DEMOGRAPHIC CHARACTERISTICS - II

EDUCATION, OCCUPATION, INCOME AND RELIGIOUS AFFILIATION

	PSU SURVEY	NATIONAL NORMS
% completing high school	74.3	68.0
% white collar	22.5	49.6
% blue collar	69.0	33.9
% farmer	1.4	3.0
% other employed	7.1	13.5
% with income above \$10,000	80.0	72.6
Religion		
% Catholic	16.8	27.0
% Protestant	73.3	61.0
% Jewish	0.4	2.0
% Other	5.2	4.0
% None	3.6	6.0
% No answer	0.7	-
% Attending Church at least weekly	40.0	40.0

TABLE 3.3
MOBILITY AND HOME OWNERSHIP

	PSU SURVEY	NATIONAL NORMS
Length of residence in area:		
Less than 1 year	6.6	-
1-5 years	19.4	-
6-10 years	15.6	-
More than 10 years	58.4	-
% Owning homes	77.3	64.0

The percentage of persons living in the area for more than 3 years is estimated to be 83.7. This estimate is arrived at by adding the percentages for more than 10 years, 6-10 years plus half of the 1-5 years group.

TABLE 3.4
HEALTH-RELATED CHARACTERISTICS

	PSU SURVEY	NATIONAL NORMS
% using sleeping pills in last 2 weeks	3.5	5.6*
% smokers	42.6	36.95
% consuming alcoholic beverages at least several times a week	23.3	23.25

*% using at least one sleeping pill in the past week.

CHAPTER 4

RESPONSE TO THE CRISIS

Introduction

This chapter will include findings from both the Penn State July and January surveys as well as in-depth interviews carried out with patients at the M. S. Hershey Medical Center and in the practice of Dr. Joseph Leaser in Middletown shortly after the crisis. The in-depth interviews dealt with experiences during the crisis period. They provided response categories used in the later telephone interviews as well as in-depth material to provide context for the telephone responses. The chapter is divided into three sections: a) the evacuation decision, b) other immediate responses to the crisis, including coping strategies and use of alcohol, tobacco, sleeping pills and tranquilizers and c) attitudes and behaviors regarding TMI in January, 1980.

Evacuation Decisions

I've gone through fire, and I've gone through flood,
(but) this radiation, you can't see ... and I guess
that's why we (left).

Approximately 60 percent of the 692 respondents to the Penn State July survey (within 5 miles of TMI) reported that at least one member of the household left during the crisis period. Fifty one percent of the respondents reported that they themselves had left. The great majority (66%) of evacuees left on Friday March 30, and an additional 12% on Saturday, March 31. (See Figure 4.1) As has been the case with other voluntary evacuations, virtually all of those who left made their own arrangements of lodging, with almost all finding accommodations with friends or relatives (See Table 4.1). Return dates were spread over

FIGURE 4.1
DEPARTURE DATES

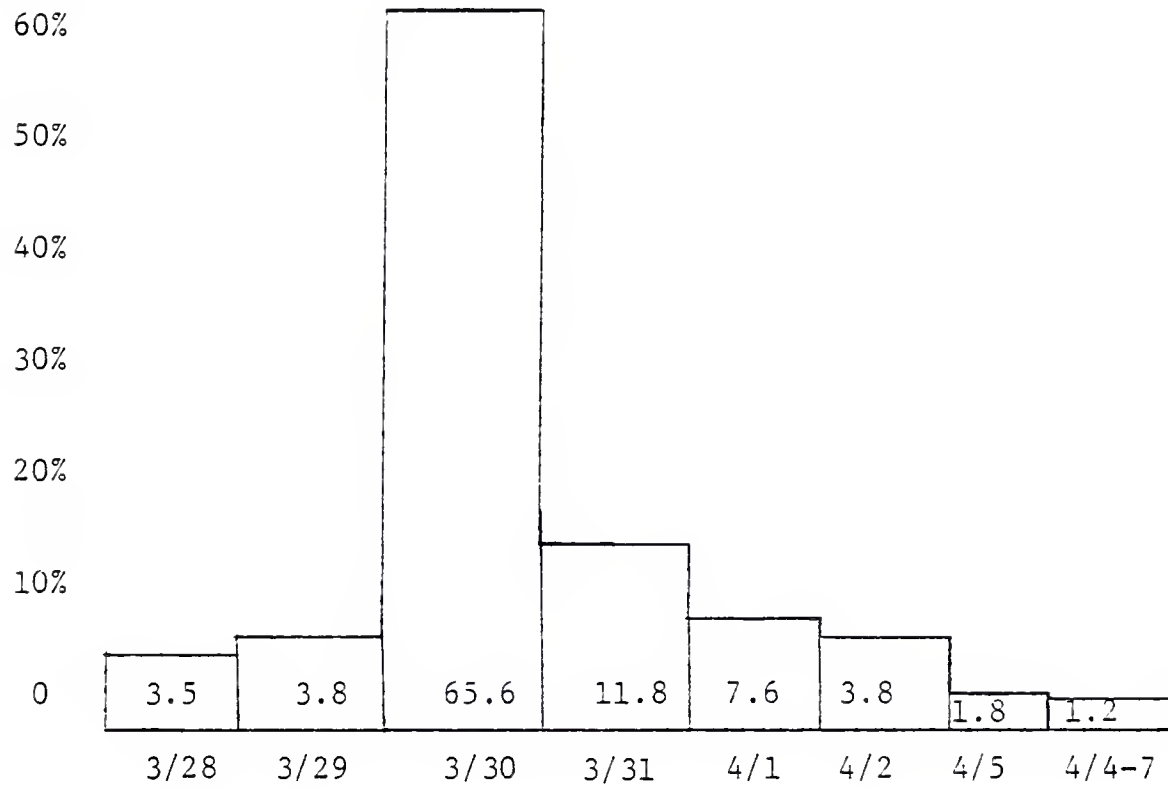
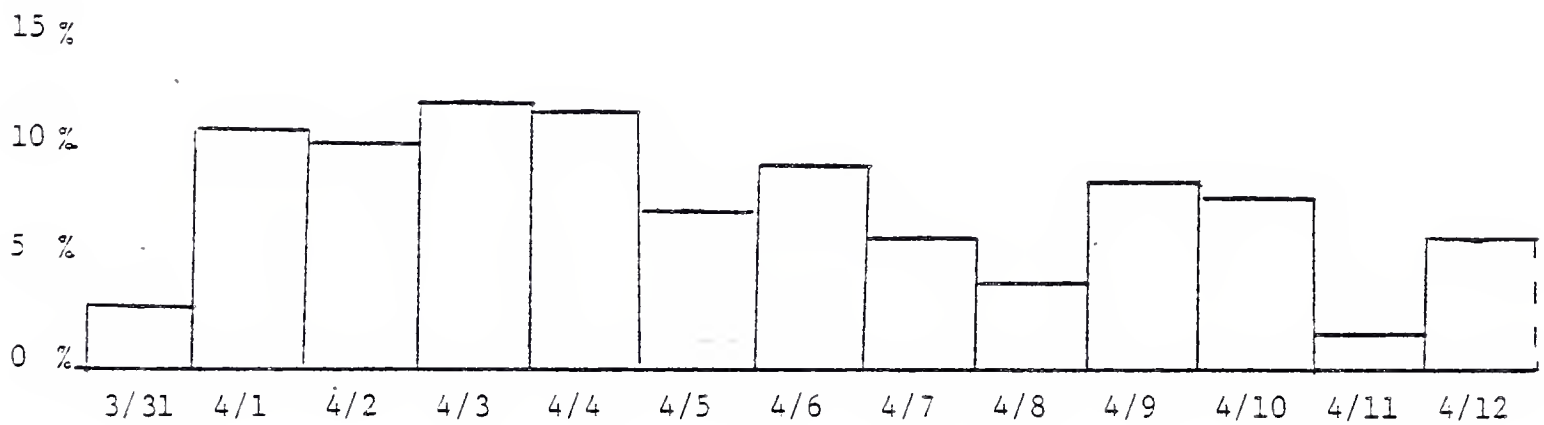


TABLE 4.1
ACCOMODATIONS FOR EVACUEES

Relatives	69%
Friends	15%
Hotel or Motel	8%
Second Home	7%
Other	1%

a much longer time period. Half of the respondents who left had returned by April 4, and 98% had returned by April 14. (See Figure 4.2)

FIGURE 4-2
RETURN DATES



Reasons for Leaving

Those who left did so for a variety of reasons (See Table 4.2). The most common one (selected by 82% of the leavers) was that the situation seemed dangerous. The in-depth interviews indicated that, for some, the perceived danger was from radiation while for others it was a more generalized fear, heavily influenced by the example of friends and neighbors, as in the example below.*

Interviewer: Why did you leave?

Respondent 1 (Wife): It was because of that bubble.

Respondent 2 (Husband): And a lot of other people were leaving.

Respondent 1: We didn't know what to expect. We didn't know what to think, what's ahead . . .

Interviewer: How dangerous did you think it was?

Respondent 1: I guess we didn't really think too much about it.

I didn't think too much about it until Sunday night. Then when they kept talking about (how) this might explode, melt down, or whatever, then we were wondering just what was going to happen. (SY0611)

A second important reason mentioned by leavers (78%) was the confusing character of the information made available to them. In some cases, the confusion arose from the simple fact that different people were saying different things. As one leaver noted,

Everything was so conflicting in the news reports. You'd hear one (local) reporter (saying) there's nothing to worry about; you hear the national (news), the place is blowing up. (SY0611)

*This and other examples which follow has been excerpted from the transcript of a series of interviews carried out at the Department of Family and Community Medicine and Pediatrics at the Hershey Medical Center and the practice of Dr. Joseph Leaser, from April 30 to June 23, 1979.

TABLE 4.2

REASONS FOR EVACUATION
(% of households where someone left)

Situation seemed dangerous	82%
Information confusing	78%
To protect children	50%
To protect pregnancy	3%
To avoid confusion of forced evacuation	68%
Pressure from someone outside of family	22%
Trip planned before accident	7%

However, for some, contradictory information seems to have led to a general erosion of trust in government and company officials:

By then (Friday, March 30) I was getting worried. Because there were too many conflicting reports, I didn't know who I should be believing anymore. I felt that the officials were probably covering up and they were trying to prevent a panic, so they weren't telling us everything.... (MY0608).

The desire to protect children was also frequently offered as a reason for evacuation (50%).

Interviewer: Why did you decide to leave? You said you were . frightened for the baby?

Respondent: Yeah, cause, you know they was talking about how it could affect him a couple of years from now. Well, his father was getting kind of crazy too, talking about if I didn't go he was (going to) take him, just the baby, so you know I wasn't gonna let that happen... (N-614)

A wish to avoid a forced evacuation was a commonly cited reason in the telephone survey (68%), although it appears to occupy a secondary role in the face to face interviews. Respondents who voiced their concern about a forced evacuation seemed to be concerned both about the mechanics of such an undertaking, as well as the possibility that warning would not be given in enough time to be of any value.

Respondent: I decided that there was more danger than I had thought, and ..., I was very worried that we weren't going to be told in time to leave. I was very skeptical of the evacuation technique, and I just thought that I would rather go myself before they ordered it. (G-608)

Responses to the item about pressure from someone outside the immediate family was a relatively infrequent choice in the telephone survey (22%).* The most common form of such pressure came from adult children, who called respondents, urging them to leave, as in the case cited below:

Respondent: ...about ten o'clock my son from Reston, Virginia called and he said "mother I've been trying for hours to get you." He said "you can't get a line into Hershey." Everybody was calling a relative or friend and telling them to come there." and he said "you get out of there fast." He works for the government, and he said "in my building there's some nuclear experts and we've been talking together today and they say that the ones in charge of this are not telling the people the story and, he said "this is terribly dangerous." He said "come down to our place..." (L-504)

Reason for Staying

Those households in which some or all members stayed also attributed their actions to a variety of motivating factors (table 4-3). The most common of these include the feeling that whatever happens is in God's hands (69.6%), the belief that the best course of action would be to wait for an evacuation order (61.9%), a belief that there actually was no real danger, (30.0%), the fear of looters (28.6%), being unable to leave a job (27.4%) and the presence of obligations at home (25.6%). The first two answers, while the most common responses in the telephone survey were rarely mentioned in the interviews. This suggests that they are "secondary" motives. That is, they were positions which were likely to be endorsed by people who also had other reasons for staying. Of the remaining reasons for staying, only the belief that there was no danger (30%) requires some elaboration. There are a number of

*It is possible that some respondents in the telephone interview who had been called by relatives urging them to leave did not list "pressure from someone outside the family" as a reason for leaving because they assumed that it referred to a non-relative.

TABLE 4-3

REASONS FOR STAYING

(% of households where someone stayed)

Whatever happens is in God's hands	69.6%
Waiting for evacuation order	61.9%
Saw no danger	30.0%
Fear of looters	28.6%
Unable to leave job	27.4%
Things to do at home	25.6%
No place to go	12.4%
Too sick or disabled to travel	4.5%
Didn't have transportation	2.4%

different reasons for this response. One was the respondent's feeling that he or she was not personally vulnerable, usually because of age.

Respondent: They (her adult children) worried about me being here, but I felt that I'm older and I didn't feel it could hurt me too much anymore. But with them being of age to have children and so forth, ... I understand that radiation has to do with sterilization...

Others felt there was no danger because of reassurance from people felt to be knowledgeable. This is often, but not always, combined with the belief that the response of the media was far too extreme, as in the case below:

Interviewer: Okay, did anything in particular happen that made you feel any more confident about staying initially?

Respondent: Conversation with my neighbor whose husband had worked (with radiation)... She was very secure that there was really nothing to worry about, any radiation... exposed to our air. ... I think sometimes the news media, just exaggerates the point on everything and that's why I just didn't get upset, 'cause you hear one reporter would say this, and the other would make it sound so serious.

Finally, some individuals felt that, while the danger might be real, it was not substantially greater than hazards which were already being faced.

Respondent: I kinda had a feeling that there's been so many other times that I'm sure we've been endangered by radioactive clouds. We had the China fallout thing a few years ago and I just figured, well, I'm sure we've been exposed to these dangers before. And where you gonna really run that you're gonna be safe: (W-0525)

Summary

It is, of course, impossible to be certain about the correctness of anyone's decision regarding evacuation. The basic facts about the actual degree of danger were unclear. It is possible, however, to make an overall assessment of the process by which individual decisions were reached.

By and large, these decisions seem to have been made in a generally reasonable way. The absence of reliable information did not lead to mass panic, nor to a widespread denial that any threat existed. Those who left did so primarily because of a desire to protect family members who seemed to be unusually vulnerable (e.g. pregnant woman and small children), and because of a general feeling that, given the lack of information, a conservative approach would probably be best. Those who stayed were aware of the possibility of danger, but seem to have concluded that the possibility of genuine harm was outweighed by the costs of leaving and the benefits of staying.

Other Responses to the Crisis

Respondents were also asked the following questions about protective measures other than evacuation:

"Has the use of cow's milk for your family changed since the TMI incident?" (Yes/No)

"Did you do any of the following things to protect the health of household members?" (Kept family inside, had tests for radiation, changed their diets.)

In spite of considerable publicity regarding the possibility of milk contamination, only 8.3% of the respondents reported any change in their use of cows' milk. Of these, 26.7% reported stopping the use of milk altogether, 15% changed to powdered milk, 18.3% changed to milk

from a distant source; the remaining 40% carried out some other change. The only other protective measure carried out by a significant proportion of the population was to remain indoors as much as possible during the period of immediate crisis. Few respondents reported either having radiation tests or changing their diets (See Table 4.4)*.

Respondents were also asked about changes in their use of alcohol, tobacco, sleeping pills and tranquilizers. While these are not direct responses to the crisis, they can be seen as efforts to deal with the anxiety associated with an uncertain situation. Generally, increases were seen for all four substances (See Table 4.5). Approximately 15% of respondents who regularly drank alcoholic beverages reported an increase in their alcohol consumption, while the comparable increase for smokers was about 32%. The total number of people using sleeping pills and tranquilizers in the two weeks following the accident was also much higher than for the two week period preceeding the interview. The use of sleeping pills during the two week period immediately following the crisis was 7.4%, but only 3.5% in July. Similarly, tranquilizers were used by 8.8% of the respondents in the two weeks after the crisis, but by only 4.8% during the two weeks just prior to the interviews in July.

Respondents were also presented with a list of possible coping strategies and asked which, if any, had helped them to deal with the crisis. When the responses to these questions were factor analyzed they were found

*The interview schedule for the face-to-face interviews contained a wider range of possible protective actions including monitoring the radio or TV, keeping bags packed for possible evacuation, keeping the car filled with gas, keeping the family together, and using bottled water. These data have not been analyzed, but it appears that at least the first three actions were relatively common.

TABLE 4-4

OTHER PROTECTIVE MEASURES

% reporting change in use of cow's milk	8.3%
% reporting doing the following things to protect family:	
Kept members inside -	55.8%
Had radiation tests -	5.9%
Changed diet -	3.0%

TABLE 4-5

CHANGES IN USE OF ALCOHOL, TOBACCO, SLEEPING PILLS AND TRANQUILIZERS
DURING CRISIS PERIOD

% Drinkers increasing alcohol use	13.6%
% Smokers increasing smoking	31.9%
% Increase in number of people reporting use of sleeping pills (compared to July, 1979)	112.5%
% Increase in number of people reporting use of tranquilizers (compared to July, 1979)	87.5%

to cluster into two relatively distinct groups (See Table 4-6.) The first consisted of a series of strategies for either distraction (concentrating on movies, TV, or reading, becoming angry, or indulging oneself), or avoidance (trying to put it out of your mind, avoiding people, or sleeping more than usual.) The second group included strategies which involved a more active seeking of information and social support, including prayer, and conversations with friends and relatives, health professionals and members of the clergy. It is interesting to note that health professionals and members of the clergy were only rarely cited as a source of support. One strategy, working harder, was equally likely to be found in both groups.

Responses in January, 1980

The findings reported above are about how people responded during the crisis period and immediately thereafter. However, studies of natural disasters generally reveal at least some relatively long-term effects, (Logue et al., 1979) and while the TMI accident produced no equivalent direct damage to property to health, the possibility of such effects remains. Consequently, it was decided to conduct a second series of interviews to examine, among other things, possible long-term effects of the crisis. As was discussed in Chapter 2, two telephone surveys were carried out in January, 1980: a re-interview of those members of the PSU sample who had given their consent to be contacted again, (the panel study) and a new random sample of the population up to 55 miles from TMI, following the same sampling procedures as used in the original NRC study. Data reported below are from the random sample out to 55 miles. Results of the panel study will be discussed in chapter 6 (to be submitted later) which will deal with what types of persons were most stressed during and after the crisis period.

TABLE 4.6

REPORTED COPING STRATEGIES

GROUP I

Try to forget the whole thing by going to movies, watching TV or reading	24.5%
Force yourself to put it out of your mind	24.1%
Let off steam by getting angry	17.8%
Avoid people, get away by yourself	12.4%
Give yourself a treat by buying something you wanted	10.6%
Sleep more than usual	5.2%

GROUP II

Pray for guidance	56.1%
Seek advice and support from friends and relatives	53.2%
Talk to a doctor or health professional	11.3%
Talk it over with a clergyman or spiritual advisor	8.8%

BOTH GROUPS

Work harder, either at your job or around the house	27.7%
---	-------

Three questions were asked about respondents' reactions to the situation at Three Mile Island in the nine months since the accident

Has the accident at TMI disrupted your life during the nine months since it happened?

It there is another similar TMI accident, do you plan to leave right away?

How do you feel about re-starting TMI? Do you support re-starting it, are you against re-starting it, or don't you care one way or the other?

Responses to the questions about disruptions are shown in Figure 4-3.

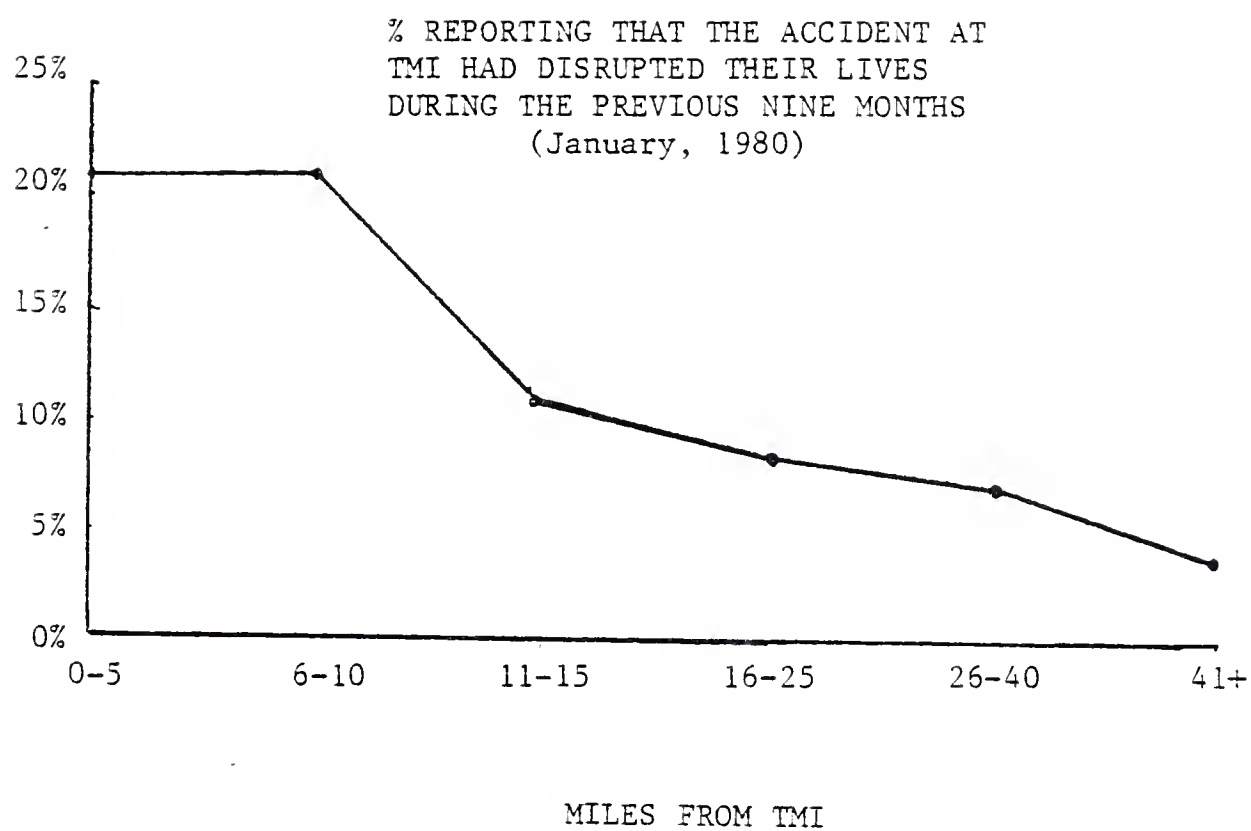
As can be seen slightly over 20% of the respondents in the 0-5 band reported that the accident had disrupted their lives during the previous nine months. This rate remains essentially stable for the 6-10 mile population, and drops rapidly thereafter, eventually declining to slightly over 3% for the 41-55 mile band. The question about evacuation decisions in the event of a similar accident produced a somewhat different pattern (See Figure 4-4). Here, responses remained very similar out to 15 miles, (0-5 = 53.5%, 6-10 = 46.0% and 11-15 = 43%), and then dropped rapidly. This pattern is also seen in responses to the question about re-starting TMI, as shown in Figure 4-5. The fact that, for all three questions, people closer to TMI showed greater disruptions and concern than did those farther away, indicates that closeness to the facility is a major factor in any long term attitudes toward TMI. This question is dealt with in detail in chapter 5.

A second impact measure concerned degree of political activity:

Have you personally, been active in any organization or gone to any meeting to influence what happens at TMI?

The responses to this question are somewhat surprising (See Table 4-7). While absolute values are not great, even for the 0-5 band, this represents a high level of political participation. While precise comparison is

FIGURE 4-3



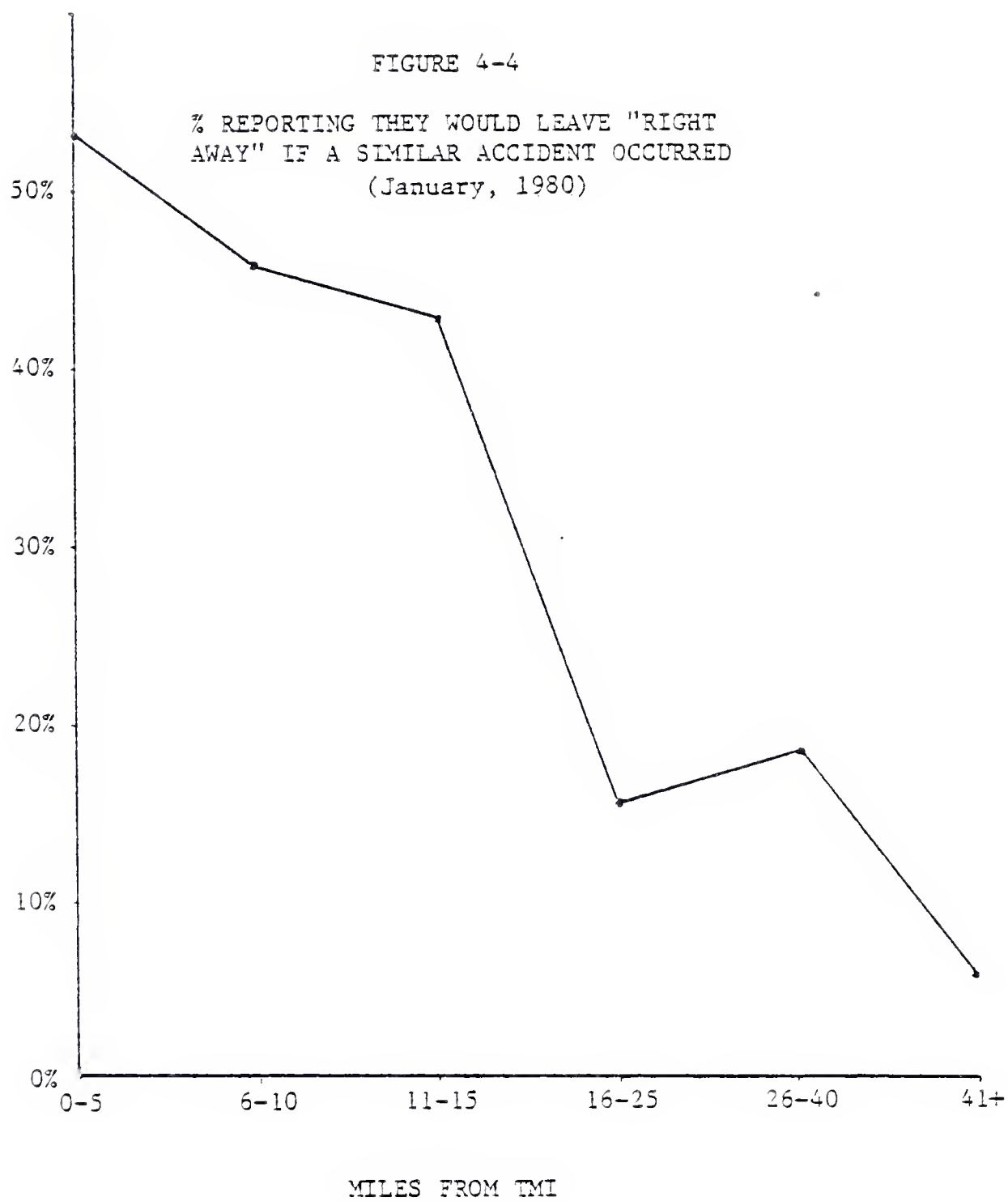


FIGURE 4-5
% AGAINST RE-STARTING TMI
(January, 1980)

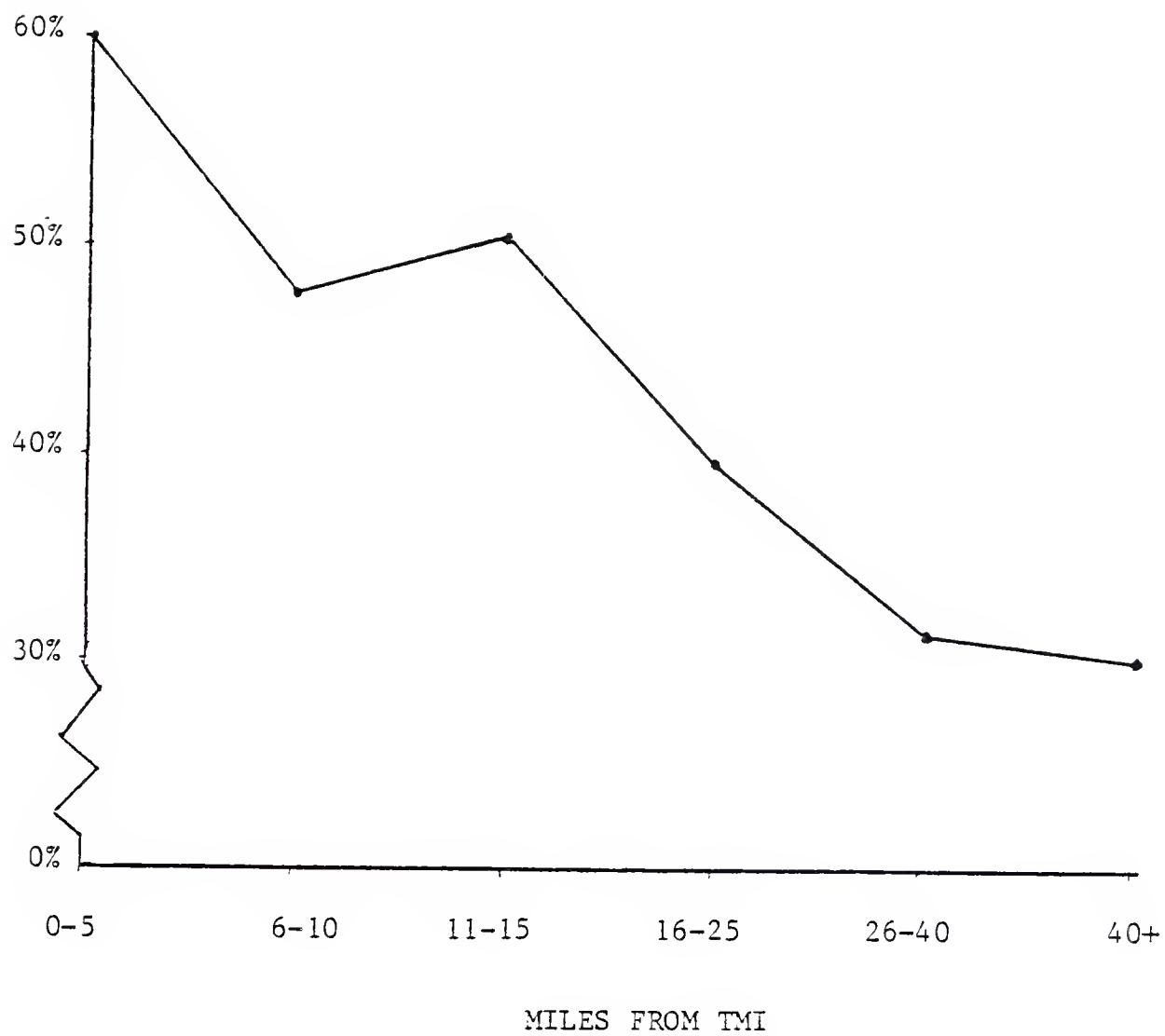


TABLE 4-7

POLITICAL ACTIVITY REGARDING TMI
APRIL 1979 - TO JANUARY 1980

MILES FROM TMI:	0-5	6-10	11-15	16-25	26-40	41+
Proportion of population reporting having been active in organization or attending meeting in order to influence what happens at TMI	12.9	9.0%	4.9%	2.9%	-	-

difficult, one generally finds that political activity of any kind is relatively rare. Thus a 1973 NORC survey found that only 5.2% of their respondents had ever participated in any kind of anti-war or pro-war demonstration, and only 9.5% had ever been involved in picketing in the course of a labor dispute. The discrepancy is even greater when one considers that the NORC questions refer to activities over an entire lifetime, where political activity related to the TMI accident could have occurred only with a period of nine months.

In chapter 5 we will consider additional findings about attitudes and symptom reporting in January, 1980. We will discuss also how the January patterns compare to responses in July.

References

Davis, James National Data Program for the Social Sciences, Chicago: National Opinion Research Center, 1973.

Logue, J., Hansen, H. and Struening, E. Emotional and Physical distress following Hurricane Agnes in Wyoming Valley of Pennsylvania Public Health Reports, 1979, 6, pp 495-502.

CHAPTER 5

INTENSITY, EXTENT AND DURATION OF DISTRESS EXPERIENCED BY THE POPULATION SURROUNDING THREE MILE ISLAND

Introduction

Data to be discussed in this chapter were collected in the July NRC study and in the January Penn State study which are described in detail in chapter 2. These studies sampled households largely with a 55 mile radius of Three Mile Island, though a small percentage of respondents in both studies extended as far as 100 miles. The fact that these surveys included persons at a considerable distance from the plant made it possible to use the farthest group, i.e. persons living beyond 40 miles of TMI, as a control group against which to compare responses of persons closer to TMI. By matching persons at different distances on demographic variables (i.e., age, sex, education, income and marital status) we can infer that, if distress is higher close to TMI, that this is related to events at Three Mile Island.* This analysis can be carried out using multiple regression analysis with dummy variables for each distance group.

It should be pointed out that the distance variable is a conservative indicator of distress due to Three Mile Island. Persons living in the farthest group may have experienced some degree of distress because of the crisis and these effects are lost in comparisons across distance. Therefore, while we may reasonably infer that, if distress levels are higher close to TMI than farther away, that this is a result of a proximity to Three Mile Island, we are not sure that this reflects all the distress that was caused by the crisis and its aftermath.

*Since not all possible demographic variables have been controlled, we cannot be absolutely certain that proximity to Three Mile Island is the only cause of distance effects, only that it is a likely cause.

Interpretation of distress responses

Three types of stress indicators were collected in these surveys: 1) direct statements about how worried, upset, etc. respondents have been about the situation at Three Mile Island, 2) the Langner index of psychological distress (Langner, 1962), and 3) respondents' reports of mental and physical symptoms that are often associated with stress. The stress-related symptoms used in this study were drawn from research on stress (Selye, 1956) as well as from interviews with patients at the Hershey Medical Center and in the practice of Dr. Joseph Leaser in Middletown immediately following the crisis. These stress-related symptoms were broken into two groups, based on a factor analysis. The first group, which deals primarily with physical symptoms, includes headaches, diarrhea, constipation, abdominal pain, sweating spells, stomach trouble, frequent urination, and rash, and we will call this group "Physical Stress Symptoms." The second group, which deals with overt behaviors, includes irritability, fits of anger, sleeplessness, loss of appetite, feeling trembly, trouble thinking, and overeating. We will call this second group "Behavioral Stress Symptoms." Results will be discussed separately for the two groups of symptoms.

Accuracy of Responses

Before reviewing the results, it is important to discuss variables which can cause discrepancies between what is reported and what actually occurred, since they must be considered in any interpretation given to the findings. There are at least five variables which can distort respondents' reports of their experiences during and after the Three Mile Island crisis.

- 1 Memory Most of the questions concerning stress asked respondents to remember events that occurred during the crisis

period or during the two weeks just prior to the interview. Since memory is rarely perfect and often selective (i.e. people tend to remember things that they think are important and sometimes forget things that are upsetting), there is ample opportunity for distortion to occur.

- 2 Mental Status It has been shown (Mechanic, 1972) that persons with poor mental status (e.g. anxiety, confusion, depression, etc.) tend to report more physical symptoms than others. It is not clear whether these people experience more symptoms or whether they simply attend to and remember symptoms which otherwise would have been forgotten. To the extent that it is the latter, people with poor mental status may report inflated symptom rates.
- 3 Willingness to Acknowledge Feelings and Symptoms Some persons are more open in telling others about their feelings and physical conditions than are others. It has been suggested that this variable may play a role in why women report more symptoms than men and why persons from certain cultural groups report higher symptom frequencies (Mechanic, 1972).
- 4 Attitudes and Commitments Many social psychological studies have shown that people tend to remember and report events in a manner that is consistent with their attitudes or their behavior (Festinger, 1957). This tendency could, for example, play a role in what pro or anti nuclear power people remember from their experiences during the crisis.
- 5 Conscious Distortion It is possible that some respondents consciously distorted their answers in hopes of affecting public policy toward Three Mile Island. For example, a

persons who is against re-opening TMI might over-state symptoms or feelings which he or she experienced during the crisis in an attempt to influence survey results toward showing that people in the vicinity of the island were experiencing distress.

Research with the Langner index and on symptom reporting in general (Mechanic, 1980) have demonstrated that they can be affected by many of these variables. Therefore, it is unlikely that reports of symptoms will match exactly how people felt during and after the crisis. As a result, in interpreting results, symptom frequencies should not necessarily be taken at face value. Instead, interpretations should be made cautiously looking at general patterns of responses and examining consistency of answers, rather than interpreting each response literally.

RESULTS

The three stress indices discussed above (feeling of concern, stress-related symptoms and the Langner index of psychological distress), will be discussed separately and then compared. Discussions will focus on differences with distance as compared to the control group (persons living beyond 40 miles from the facility).

Feelings of concern about TMI

Two questions concerning feelings about TMI were asked in both the July 1979 survey as well as in the January 1980 survey. Results will be reported separately for each question. The first question asked about how upset the respondent was about TMI. The exact phrasing was as follows.

- 1) How upset do (did) you feel about the situation at Three Mile Island?

extremely upset
quite upset
somewhat upset
a little upset
not at all upset
don't know

This question was asked twice; first in the July 1979 survey when respondents were asked how they had felt in April 1979, during the crisis period, and, second, in the January 1980 survey when they were asked how upset they presently felt.

Results are reported in figures 5-1 and 5-2. Data are presented in two ways. First is the percent of persons within each distance group who reported being extremely or quite upset about the situation at Three Mile Island (figure 5-1). This chart shows a sharp overall drop from April 1979 to January, 1980, though both lines are higher close to TMI. It is interesting to note that, even in the farthest group, over 20% were extremely or very upset in April and 7% still felt this way in July. This indicates, as suggested earlier, that distress was experienced to some degree even in the farthest group.

Second, these same data are reported after using multiple regression analysis to control for a number of demographic variables (age, sex, education, income and marital status), which differed somewhat at different distances, and, therefore, may have distorted the results. These "refined" results are shown in figure 5-2 in terms of variations from the farthest group (beyond 40 miles). Figure 5-2 also shows where response levels are significantly different from the response levels beyond 40 miles when age, sex, education, income and marital status have been controlled.

Figure 5-2 shows a marked distance effect in April, 1979 immediately following TMI, as well as in January, 1980, though the percentages for January within 15 miles are half what they were in April. In April, the

FIGURE 5-1
% OF RESPONDENTS EXTREMELY UPSET
OR QUITE UPSET ABOUT TMI
AT VARYING DISTANCES FROM THREE
MILE ISLAND

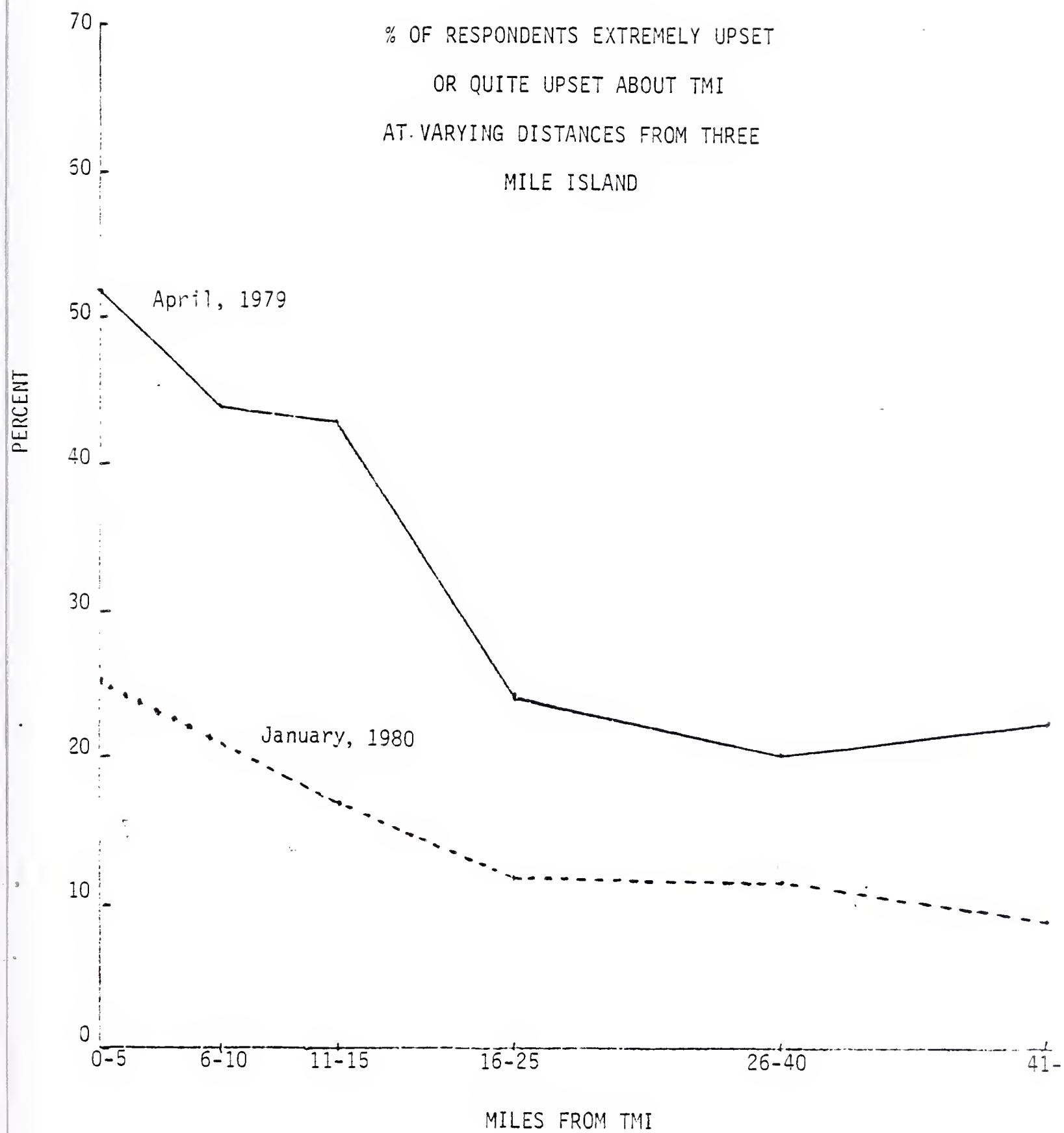
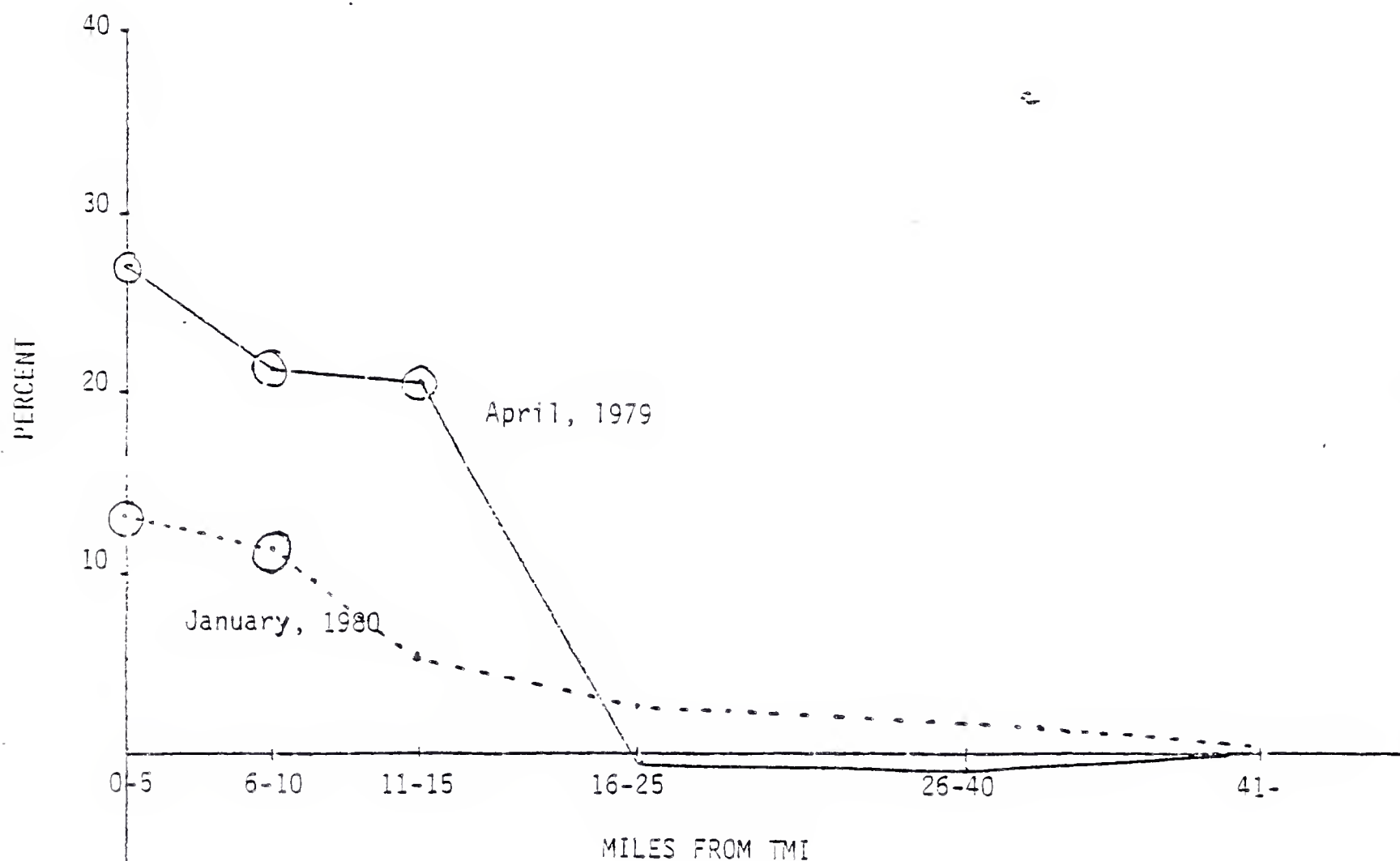


FIGURE 5-2
CORRECTED* PERCENT OF RESPONDENTS EXTREMELY
OR QUITE UPSET ABOUT TMI
AT VARYING DISTANCES FROM THREE MILE ISLAND
PLOTTED AS DIFFERENCES FROM THE GROUP BEYOND 40 MILES



- 10 - *Age, sex, education, income and marital status controlled

A circled point indicates that the percent of persons who are extremely or very upset about TMI at that distance is significantly greater than the percent of persons beyond 40 miles who are extremely or very upset

probabilities of being extremely or very upset are significantly higher than the farthest group for the 0-5, 6-10 and 11-15 mile groups and then drop to below the level of statistical significance beyond that. In January, they are significantly different for only the 0-5 and 6-10 mile groups.

The second question concerns perceived threat to the respondent and his or her family. This question was phrased as follows.

How serious a threat do (did) you feel the Three Mile Island Nuclear Station is (was) for you and your family's safety?

a very serious threat
a serious threat
somewhat of a threat
no threat at all
don't know

This question was asked in the July, 1979 survey about how respondents had felt in April, immediately following the accident as well as for how they felt in July. The same question was also asked in the January survey for how respondents felt in January.

Results are shown in figures 5-3 and 5-4. The methods of analysis were the same as for the previous question and the findings are strikingly similar. While the overall percentages dropped sharply from April to July, (Figure 5-3), there was relatively little change from July, 1979 to January, 1980. When the three time periods are plotted as deviations from the farthest group with demographic variables controlled (figure 5-4) the three time periods are strikingly similar. There is a 10 percent drop from April to July with January scores between the two. For all three times the 0-5, 6-10 and 11-15 mile groups are significantly higher than the group beyond 40 miles.

Frequency of "physical stress symptoms" (i.e. headache, diarrhea, constipation, abdominal pain, sweating spells, stomach trouble, frequent urination and rash) are summarized in Figures 5-5 and 5-6. Results are reported in terms of percent of persons who reported at least one of these

FIGURE 5-3

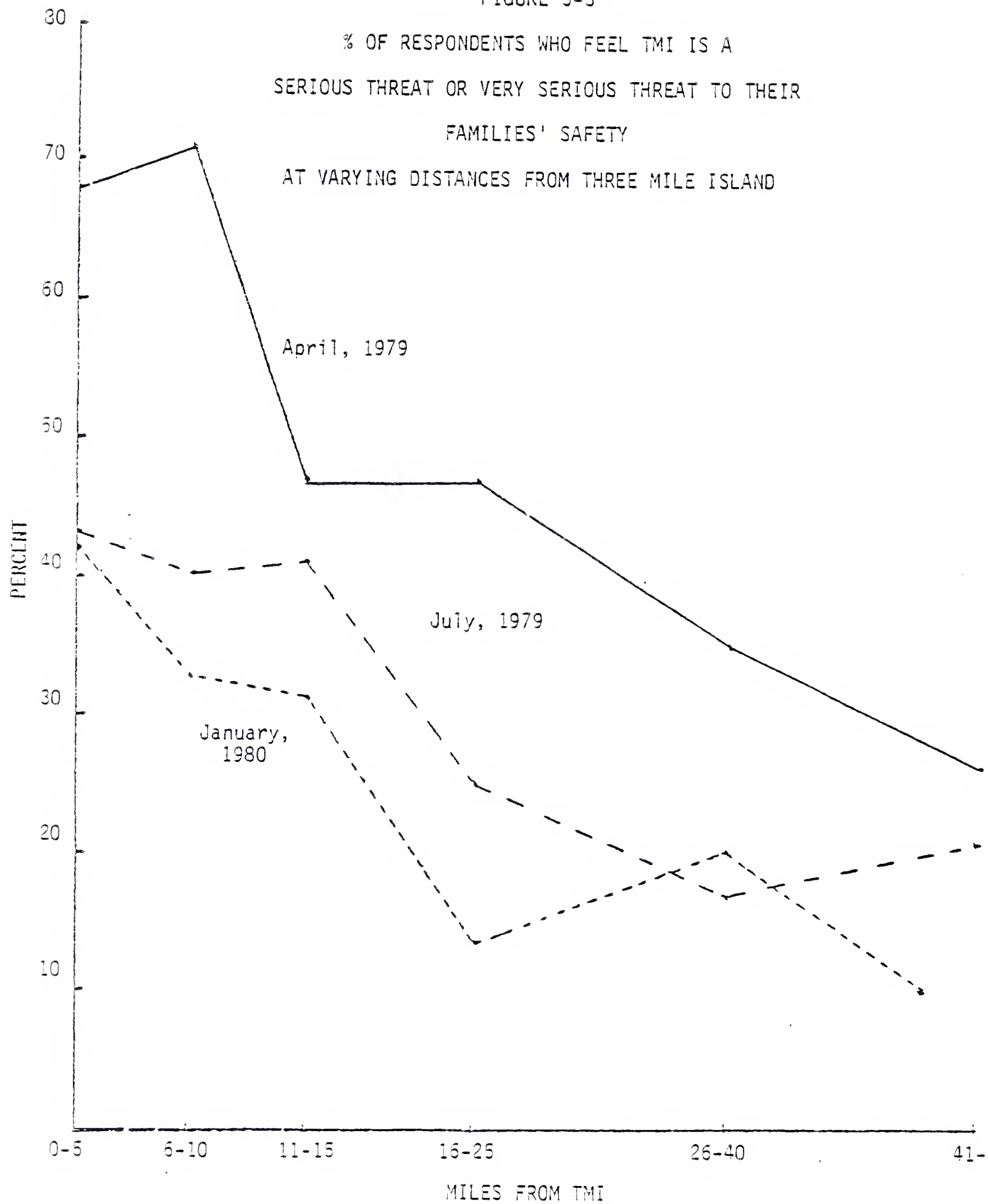
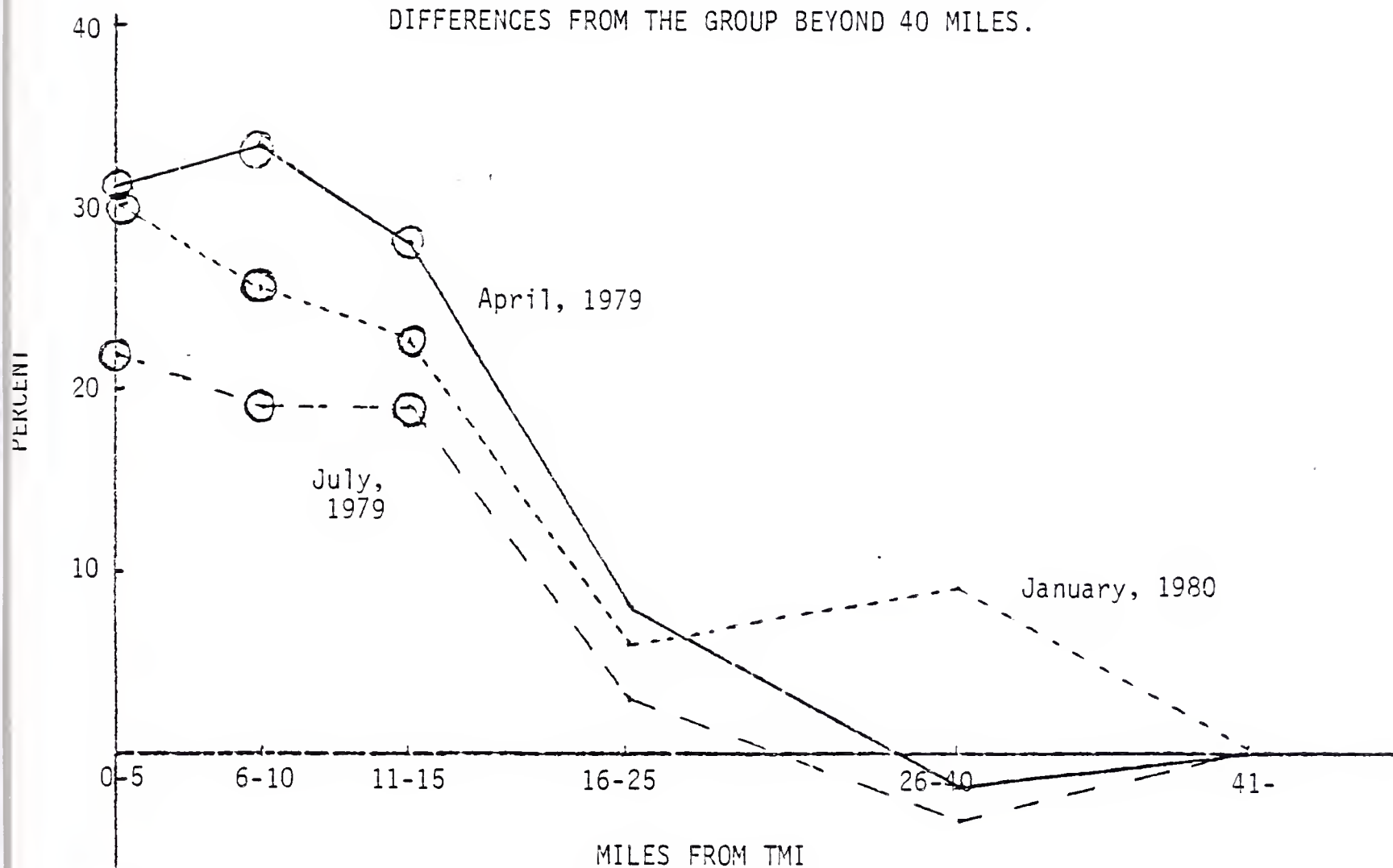


FIGURE 5-4

CORRECTED* PERCENT OF RESPONDENTS WHO FEEL TMI IS A SERIOUS
OR VERY SERIOUS THREAT TO THEIR FAMILY'S SAFETY AT
VARYING DISTANCES FROM THREE MILE ISLAND PLOTTED AS
DIFFERENCES FROM THE GROUP BEYOND 40 MILES.



*Age, sex, education, income and marital status are controlled

A circled point indicates that the percent of persons feeling that TMI is a very serious or serious threat at that distance is significantly greater than the percent of persons beyond 40 miles who feel TMI is a very serious or serious threat.

symptoms for each time period. Data analysis and presentation format are the same as for the two questions cited earlier.

The percent distributions, shown in figure 5-5, show large overall differences for April, July and January. The highest rates are reported in January, followed by July and then April. The fact that July rates are higher than April are possibly due to memory since both sets of data were collected in July. Therefore, in answering about April, respondents had to remember back three months, but in answering about July, they only had to remember for the two weeks just prior to the interview. The higher rates for January than July are possibly due to seasonal variations in symptom reporting rather than memory since both involved memory for only the past two weeks. The Health Interview Survey, a nationwide survey conducted by the National Center for Health Statistics, reports that acute symptoms are, on the average, 1.4 times higher in January than in July (DHEW Publication No. (PHS) 79-1560). This is approximately the same as the differences found here.

The fact that all three sets of data slope, that is, are higher close to TMI than far away, suggests that, as with the attitude measures reported earlier, closeness to TMI did have an influence on symptom reporting. Figure 5-6 makes this point more convincingly because demographic variables (i.e. age, sex, education, income and marital status) have been controlled and probabilities are plotted as deviations from the control group (beyond 40 miles) which eliminates the general level differences and allows comparisons of the slopes alone. Figure 5-6 not only shows raised response frequencies close to TMI, it also shows a sharp drop between 15 and 25 miles, the same as with the attitude data. Statistical significance, as shown in figure 5-6 also drops after 15 miles. The percent of the population above baseline at all three times is approximately ten percent.

PERCENT OF RESPONDENTS WITH ONE OR MORE PHYSICAL STRESS SYMPTOMS

AT VARYING DISTANCES FROM THREE MILE ISLAND

(HEADACHE, DIARRHEA, CONSTIPATION,
ABDOMINAL PAIN, SWEATING SPELLS,
STOMACH TROUBLE, FREQUENT
URINATION, AND RASH)

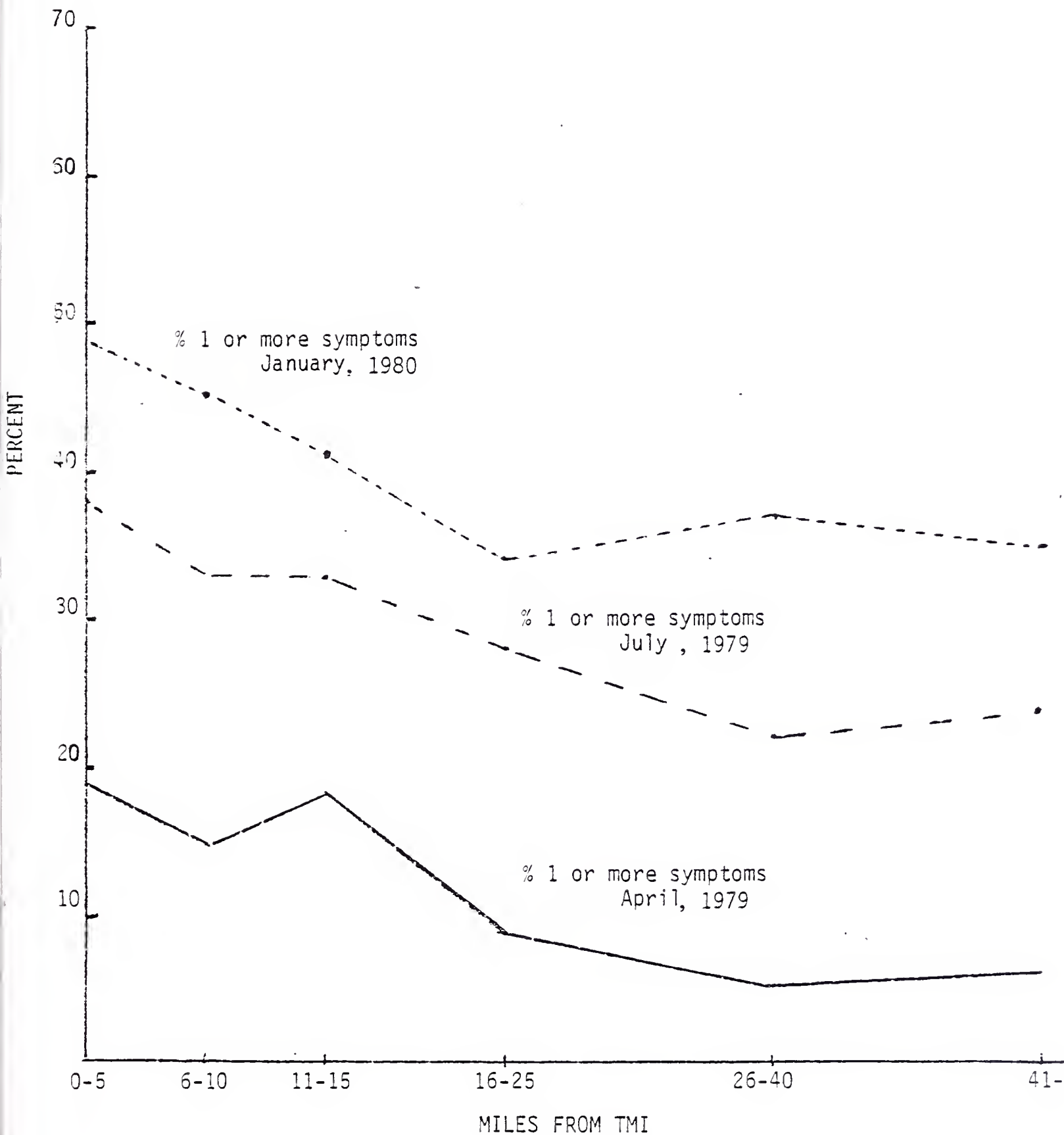
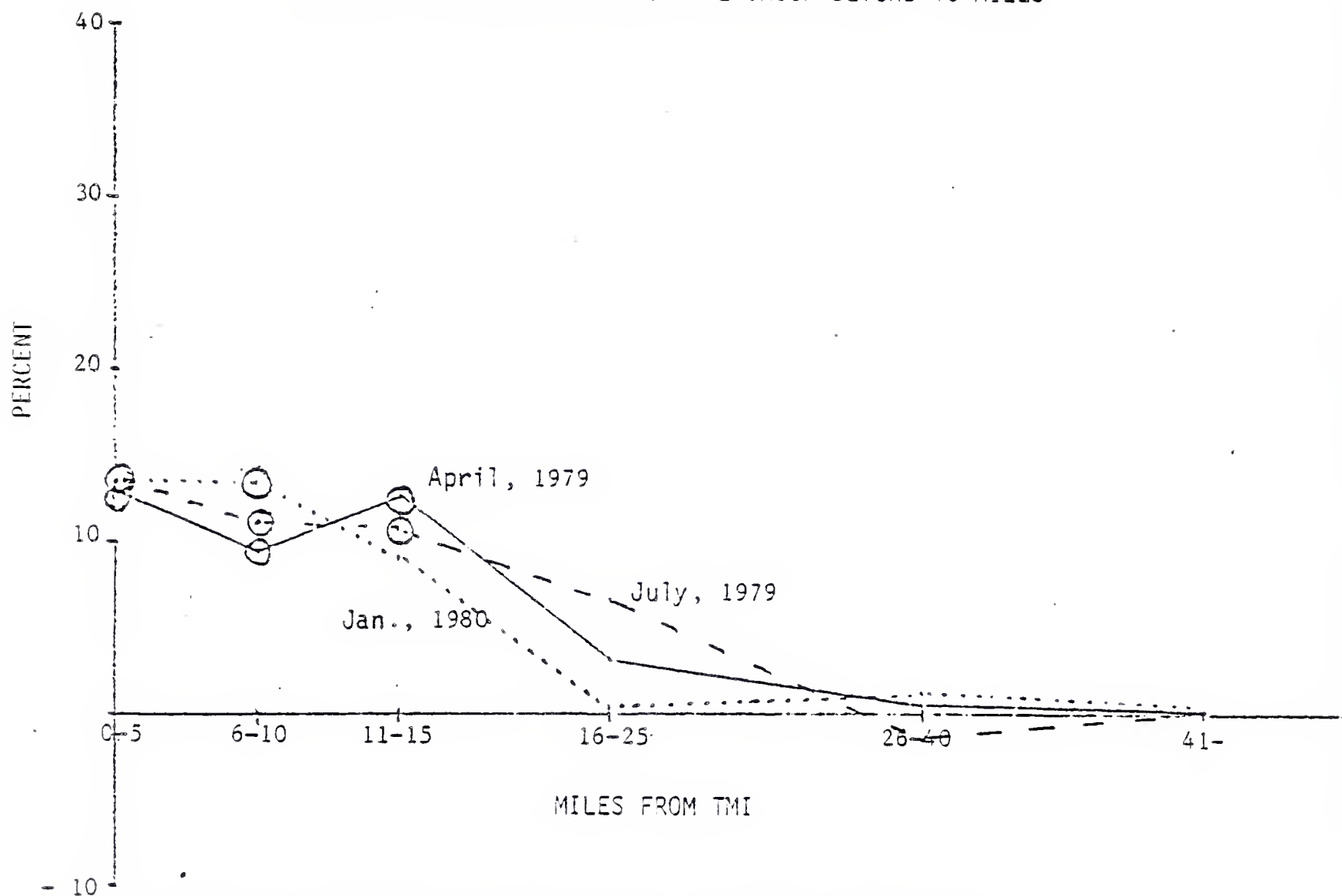


FIGURE 5-6
 CORRECTED* PERCENT OF RESPONDENTS
 WITH ONE OR MORE PHYSICAL STRESS SYMPTOMS
 AT VARYING DISTANCES FROM THREE MILE ISLAND
 PLOTTED AS DIFFERENCES FROM THE GROUP BEYOND 40 MILES



* Age, sex education, income and marital status controlled

A circled point indicates that the percent of persons who report at least one symptom at that distance is significantly greater than the percent of persons beyond 40 miles who report at least one symptom.

Analysis of "behavioral" stress symptom reporting (i.e. loss of appetite, overeating, trouble sleeping, feeling trembly or shaky, trouble thinking clearly, irritability and extreme anger) is shown in figures 5-7 and 5-8. The method of analysis and presentation parallels those reported earlier. Figure 5-7 shows some general level differences among the three time periods, as was found with the "physical" stress symptoms. These are probably due to the same causes. Figure 5-8, which includes controls for demographic variables as well as differences in general levels, again shows significantly higher levels of symptom reporting compared to the control group out to 15 miles for April and January, but during July for only the 0-5 mile and 11-15 miles groups. Figure 5-8 also shows highest rates within 15 miles for January followed by April and July. There is a rise in symptom reporting in January for the 26-40 mile group, but this is not significantly different from the group beyond 40 miles. In general, this figure repeats the patterns of the other measures, showing raised levels of symptom reporting out to 15 miles for April, July and January.

The last set of data to be reported here are responses to the Langner index of psychological distress which was included only in the January survey. This scale includes questions about depression, anxiety and some psychosomatic symptoms. Data were analyzed in the same manner as for the other distress indices. However, in this case, there were no statistically significant differences between groups close to TMI and the farthest comparison group.

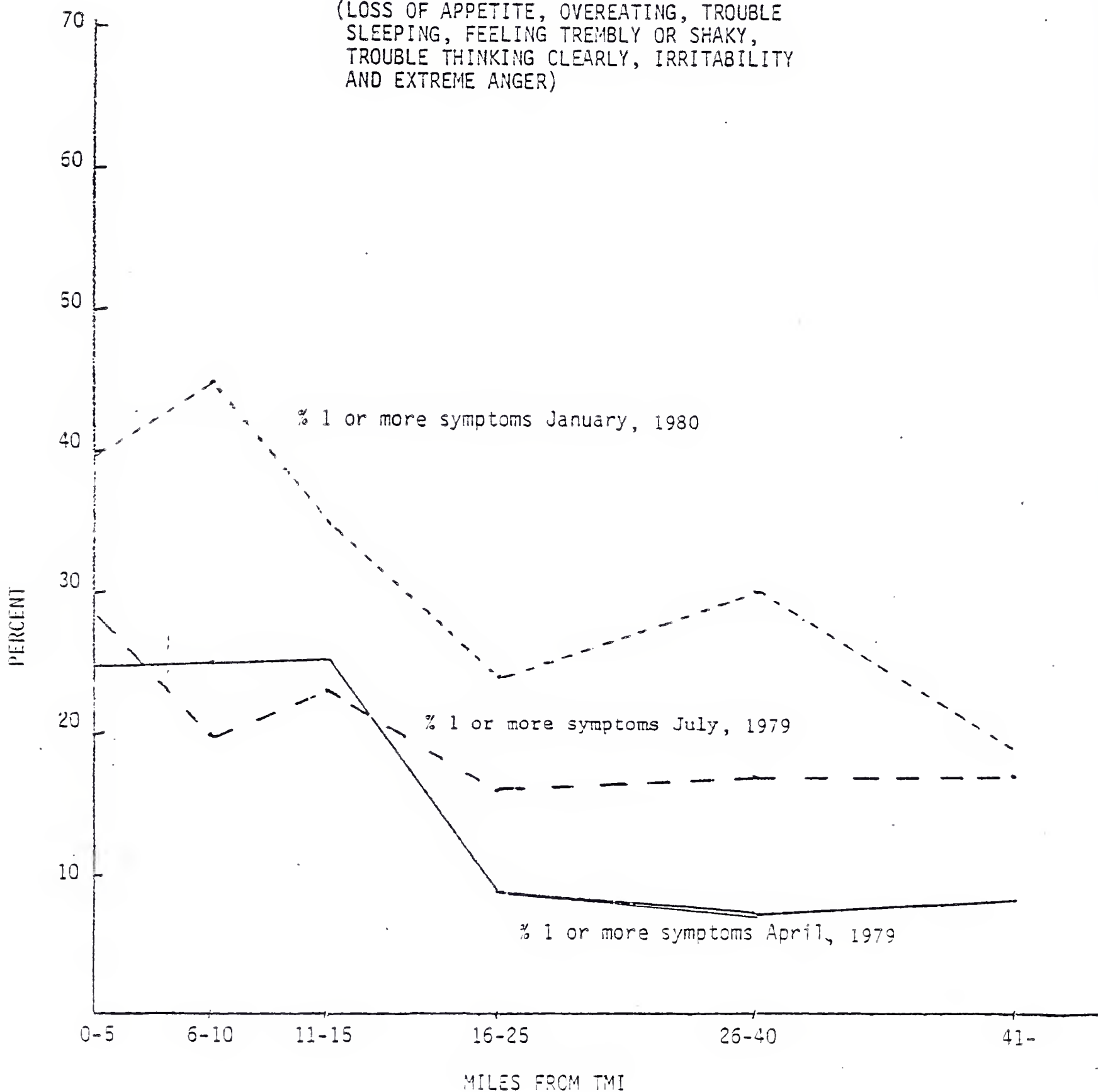
DISCUSSION

As was pointed out earlier, there are a number of variables that can affect symptom reporting rates in addition to actually having symptoms. As a result, we cannot be certain that what people report is the same as what they experienced. However, it is possible to make some inferences from the general pattern of results that do not require accepting responses at face value.

FIGURE 5-7

% OF RESPONDENTS WITH ONE OR MORE BEHAVIORAL STRESS SYMPTOMS
AT VARYING DISTANCES FROM THREE MILE ISLAND

(LOSS OF APPETITE, OVEREATING, TROUBLE
SLEEPING, FEELING TREMBLY OR SHAKY,
TROUBLE THINKING CLEARLY, IRRITABILITY
AND EXTREME ANGER)



HEALTH RELATED BEHAVIORAL IMPACT OF THE THREE MILE ISLAND NUCLEAR INCIDENT

PART II

Report submitted to the TMI Advisory Panel on Health Related Studies
of
The Pennsylvania Department of Health

November 21, 1980

*Peter S. Houts, Ph.D., Principal Investigator

with

*Robert W. Miller, Ph.D.

**George K. Tokuhata, Dr. P.H., Ph.D.

**Kum Shik Ham, Ph.D.

*The Pennsylvania State University College of Medicine
and

**The Pennsylvania Department of Health

Contents

Chapter 6: Characteristics of persons distressed
during and after the incident at Three
Mile Island

Chapter 7: Summary of findings with relevance
to public policy

Introduction

Findings to be presented here are Part Two of a report to the TMI Advisory Panel on Health Research Studies. The acknowledgements of assistance for Part One also apply to Part Two with two additions. We would like to acknowledge the help of Ms. Jane Todd Cooper in organizing material used in sections of this report. We also appreciate the secretarial assistance of Mrs. Robin Long.

Part One contained a description of methodology utilized, sample selection, description of reactions during the crisis period and persistence of distress over a nine month period from the original crisis. Part Two contains two chapters: Chapters 6 and 7. Chapter 6 includes two topics: 1) characteristics of persons who were distressed during the initial crisis in March and April, 1979, and 2) characteristics of persons who increased or decreased distress over the nine month period from April 1979 to January 1980. Chapter 7 is a summary of findings from both parts of this study which have relevance for public policy. We feel, in view of the widespread public interest in events during and after the incident and the possibility that these experiences will influence future public policy, that there should be a summary of findings with qualifications and conditions necessary for drawing implications for public policy.

In the introduction to Part One of this report it was stated that Part Two would include a discussion of the impact on the Three Mile Island Incident on the Health Delivery System. This material will be presented by Dr. Teh Hu in his report on the economic impact of the Three Mile Island Incident.

Chapter 6

CHARACTERISTICS OF PERSONS DISTRESSED DURING AND AFTER THE THREE MILE ISLAND INCIDENT

Background

Stress resulting from the Three Mile Island crisis was largely psychological. The crisis did not cause physical damage and the disruption due to evacuation was limited because people returned to unchanged homes and normal routines. Furthermore, no immediate health effects from radiation were observed. Although the immediate crisis situation was mitigated by mid-April, the future of the facility and how it was to be "cleaned up" remained unresolved. Publicity about problems at the plant and possible future dangers continued for many months.

Public reference to the incident was continuous from March 28, when the crisis at the nuclear power plant was first publicized, until the end of May. There were daily references to the situation at Three Mile Island in the Harrisburg Patriot and the Harrisburg Evening News and frequent references in the daily papers of York and Lancaster, two other major population centers within 15 miles of the power plant. From June until the January survey, references were less frequent but at least weekly with the exception of November. When the Kemeny report was issued in November, daily references to TMI occurred again for approximately 1 week. Local weekly newspapers also printed many articles on TMI in April and May with another group of articles in November. In addition the Readers Guide to Periodical Literature lists over 100 articles about TMI printed in magazines with national circulations between April and December 1979.

As a result of this continuous publicity, situation at Three Mile Island changed from a short term crisis to a chronic, unresolved problem for many people living near the facility. While the percent of the population who were very distressed dropped sharply by July, there remained a substantial number

of people who were still very concerned about Three Mile Island nine months after the original crisis (see Chapter 5 of this report for substantiating data.) The purpose of this chapter is to examine what characterized persons who a) were distressed during the crisis period and b) who changed their levels of distress from April, 1979 to January, 1980.

Population

Two surveys studied individual differences in response to the crisis among the population living within 0-5 miles of TMI. As explained in Chapter Three, 692 persons who lived within 5 miles of TMI were interviewed in July about their experiences and feelings during the 2 weeks in April immediately following the crisis at TMI and for the 2 weeks in July immediately preceding the interview. At the end of the interview, each respondent was asked if he/she would be willing to be re-interviewed at a later time. Five hundred eighty two people, or 81%, agreed, and their names and numbers were recorded. No identifying information was taken from those who refused. In January, 1980, 467 of these 582 persons who agreed to be re-interviewed were contacted and 403 were interviewed a second time (58.2% of the original sample of 692). Nine of those contacted refused re-interviews, 46 had disconnected phones, while nine did not answer on four calls.

A comparison of demographic characteristics of the January sub-sample with the original sample of 692 is shown in Table 1. The demographic characteristics of the July sample and the January sub-sample are remarkably similar. The January sample includes slightly more married homeowners who evacuated during the crisis. Other differences are quite small, with the percent of males exactly 52.1% in both samples.

COMPARISON OF DEMOGRAPHIC CHARACTERISTICS
OF JANUARY SAMPLE AND TOTAL SAMPLE

	TOTAL (Sample N = 692)	JANUARY (Sample N = 403)
Respondent's mean age	42.4	41.6
% male	52.1	52.1
% widowed, separated or divorced	15.5	15.0
% single	10.9	7.0
% married	73.6	78.0
Mean family size	3.1	3.2
Mean years of schooling	11.9	12.0
% with income over \$10,000	80.0	82.1
% owning homes	77.8	83.1
% of respondents who evacuated during crisis	50.1	55.1
% Pennsylvania Dutch*	42.0	41.4

*By Pennsylvania Dutch is meant descendants of German and Swiss immigrants who settled in the area in the 18th and early 19th centuries.

Measures of Stress

Three measures indicating personal distress because of TMI were collected in both July and January.

1. In the July survey, respondents were asked, "Please tell me whether (you) were upset during the Three Mile Island crisis? Were you extremely, quite, somewhat, or a little upset?" In January, the question was rephrased, "How upset do you feel now about the situation at Three Mile Island?"
2. In the July survey, respondents were asked, "On Friday, March 30, how worried were you about the safety of other people in your family? Were you extremely worried, very worried, somewhat worried, a little worried, not at all worried?" In January the question was rephrased to ask, "How serious a threat do you feel the Three Mile Island Nuclear Station is now for you and your family's safety? Was it a very serious threat, a serious threat, somewhat of a threat or no threat at all?"
3. In the July survey, respondents were asked if they had experienced any of 15 stress-related symptoms during the 2 weeks immediately following the Three Mile Island incident. If they responded "Yes" to any symptom, they were asked if they thought this was a result of the Three Mile Island incident. The number of symptoms attributed to Three Mile Island can be interpreted as an indication of distress felt about Three Mile Island. If a respondent felt he/she was experiencing physical symptoms because of Three Mile Island, this was taken as an indication that he/she was upset about Three Mile Island. In the January survey, respondents were asked if they had experienced the same 15 stress-related symptoms during the past 2 weeks. They were also asked if they thought their symptoms could be due to TMI.

Note that these are reported symptoms, not symptoms actually experienced. As explained in Part One of this report, many factors, in addition to actually having a symptom, can affect symptom reporting. For our purposes, though, attributing symptoms to Three Mile Island can be taken as an indication of being upset about TMI without assuming that the symptoms actually occurred.

The distress levels during the crisis period and in January 1980 for each of the three distress measures are reported in Tables 2, 3 and 4. These tables include cross tabulations showing how many distress scores increased, decreased or remained the same for each measure. They show that, for all measures, the tendency was for distress to decrease over time though the change for attributed symptoms was not statistically significant.

TABLE 2

CROSSTABULATION OF RESPONSES TO QUESTIONS ABOUT HOW UPSET THE RESPONDENT WAS DURING THE THREE MILE ISLAND CRISIS AND IN JANUARY, 1980.

	UPSET JANUARY, 1980					Totals
	4 extremely	3 quite	2 somewhat	1 little	0 not upset	
UPSET DURING TMI CRISIS						
4 extremely	16	25	20	18	14	94
3 quite	2	18	19	14	6	59
2 somewhat	8	6	12	14	22	63
1 little	1	7	16	19	40	83
0 not upset	2	3	7	17	73	103
don't know	0	0	0	0	1	1
Totals	29	59	74	82	156	403

Item scores (extremely = 4, quite = 3, somewhat = 2, little = 1, not = 0)
 TMI crisis mean = 1.90
 January 1980 mean = 1.31
 t test of difference between means = 6.46, 399 d.f., $p < .01$
 Correlation between the two upset scores = .48, $p < .01$.

TABLE 3

CROSSTABULATION OF RESPONSES TO QUESTIONS ABOUT RESPONDENT'S CONCERN FOR

SAFETY DURING THE TMI CRISIS AND IN JANUARY, 1980

(January, 1980)

HOW SERIOUS A THREAT DO YOU FEEL TMI IS FOR YOU AND YOUR FAMILY'S SAFETY

	very serious	serious	somewhat of a threat	no threat at all	don't know	Totals
extremely	42	53	35	23	2	155
very	10	19	27	13	1	70
somewhat	3	12	34	23	0	72
little	3	6	23	20	4	56
not at all	5	2	10	29	0	46
don't know	0	0	2	1	1	4
Totals	63	92	131	109	8	403

Correlation between concern about safety during TMI crisis and in January 1980 = .40, $p < .01$
(Means are not comparable for the two time periods since a 5 point scale was used in the July survey and a 4 point scale was used in the January survey.)

TABLE 4

CROSSTABULATIONS OF NUMBER OF SYMPTOMS ATTRIBUTED TO THE SITUATION AT THREE MILE ISLAND
DURING THE CRISIS IN MARCH-APRIL AND IN JANUARY, 1980

NUMBER OF SYMPTOMS ATTRIBUTED TO TMI JANUARY, 1980

NUMBER OF SYMPTOMS ATTRIBUTED TO TMI DURING CRISIS	6 or more	6 or more						Totals					
		5	4	3	2	1	0	5	4	3	2	1	0
5	5	1	0	0	0	0	5	11					
4	1	0	0	1	1	0	2	5					
3	0	1	1	0	0	0	10	12					
2	1	1	0	1	1	1	8	13					
1	1	0	2	0	1	0	10	14					
0	0	2	1	3	0	1	21	28					
	6	4	1	3	4	1	301	320					
Totals	14	9	5	8	7	3	357	403					

Mean number of attributed symptoms during TMI crisis = .598

Mean number of attributed symptoms in January, 1980 = .566

t test of difference between means = -.34, 402 d.f., not statistically significant.

Correlation between number of symptoms attributed during TMI crisis and in January, 1980 = .37, $p < .01$.

Demographic characteristics

Sex, income, education and marital status have all been shown to relate to reported emotional distress (Kessler, 1979).

The most common pattern has been that females, low income, low educational and widowed, separated or divorced persons are especially likely to report physical or psychological distress. It should be pointed out, however, that there is disagreement among researchers as to the universality of these relationships or what causes them. For example, there is considerable debate about why women usually report more physical and psychological symptoms than men. Some argue that women's role in society is more stressful than is men's. Some argue that women are more willing to acknowledge sickness publically and some argue that there is a biological reason (Mechanic, 1978). We will not be able to resolve these issues in the findings to be reported here, but it is important to recognize that there are many interpretations possible for findings in this area. The following demographic characteristics were available for respondents in this study: age, sex, education, income and marital status.

Coping

A number of researchers have proposed that coping plays a role in how people react under stress. Cohen and Lazarus, (1979) suggest that how one views stress influences how one reacts to it. If the situation is viewed as a challenge from which gain, growth or mastery may occur, coping will be directed at gaining control and feelings about the situation will be positive. However, if the situation is viewed as one where mastery is not possible, coping efforts are likely to be defensive and feelings about the situation are likely to be negative. This suggests that the degree and severity of distress experienced as a result of the Three Mile Island Incident may be affected by whether people feel they can affect the situation or whether it is a problem over which they have no control.

Questions about twenty coping strategies were included in the July and January surveys. In the July survey respondents were read a list of 15 coping strategies and, after each one, were asked if they had made use of it. These strategies are listed in Chapter 4, Table 4.6. The strategies were divided into two groups: "avoidance" strategies (Type I in Table 4.6) and "social" strategies (Type II in Table 4.6) on the basis of a factor analysis. Each respondent was given an "avoidance" and a "social" score consisting of the number of strategies he/she used in each group.

The avoidance and social strategies were primarily concerned with reducing anxiety. One other question also concerned how people dealt with anxiety: "During the two weeks following the Three Mile Island incident, did you take any tranquilizers or nerve medicine to help you feel less tense?" In addition, four other questions were included in the surveys which asked about strategies to deal with perceived danger from TMI.

1. "Has the use of cow's milk for your family changed since the TMI incident?"
2. "Did you do any of the following things to protect the health of household members? Kept family inside, sent them out of the area, had tests for radiation, changed their diets."
3. "Did you leave the area during the 2 weeks following the Three Mile Island incident?"
4. "Have you, personally, been active in any organization or gone to any meetings to influence what happens at TMI?"

Social Support

Cobb (1976) has reviewed a number of studies indicating that social support may serve as a buffer to moderate the effects of a stressful situation on an individual. By social support is usually meant having persons available to give encouragement and support. This usually occurs through friendship and family relations.

Another kind of social support, which we will call "community roots" can come from sharing values with others in the community and having commitments to community institutions. Community roots implies a sense of involvement with the community as a whole rather than with specific individuals. Several questions were included in these surveys which are indicators of community roots including being "Pennsylvania Dutch" (the predominant cultural group in the community) coming from a family which has lived in the area for several generations, attending church and owning a home. Following are the questions included under these definitions of social support and community roots.

Social Support

1. "How many friends or relatives do you have that you feel close to, that is, people that you feel at ease with, can talk to about private matters, and can call upon for help?"
2. The following four questions concerning availability of help were summed into one score.
 - a. If you were so upset in the middle of the night that you needed someone to talk to immediately, is there someone immediately available within your household whom you could talk to?
 - b. If you were so upset in the middle of the night that you needed someone to talk to immediately is there someone immediately available outside of your household whom you could call on?
 - c. Do you have any difficulty finding people with whom you can discuss upsetting personal problems?
 - d. Do you have any problems you can't discuss with any friend or relative? (A "no" answer scored as positive.)

Community Roots

1. "As far back as you can remember, how long has your family lived in this area?"
2. "Do you own or rent your home?"
3. "How often do members of your family attend a church at the present time?"
4. "Many people think of themselves as coming from a certain ethnic background. Is your family background primarily Pennsylvania Dutch?" (Pennsylvania Dutch is the predominant ethnic group in the area.)

Sensitivity to Stress

A number of studies (for example, Canter, Imboden and Cluff, 1966) have shown that persons with a history of emotional problems are especially sensitive to and react strongly to stressful situations. Furthermore, studies on illness behavior (Mechanic, 1978) have shown that symptom reporting is frequently associated with mental distress and with a tendency to attend to one's bodily state. In addition, there are unique features of the Three Mile Island incident which might make certain persons especially sensitive during and following the crisis: 1) seeing the cooling towers from one's home or place of work and, 2) having young children or children in utero at the time of the crisis.

Information was obtained on the following individual characteristics which are possible indicators of sensitivity to stress during and after the TMI crisis:

1. Whether a respondent had a history of any of 13 chronic physical illnesses including arthritis, heart disease, diabetes, skin disease, etc.

2. Whether a respondent had a history of any of 4 mental problems: insomnia, severe depression, severe anxiety or nervous breakdown requiring hospitalization.
3. Whether anyone in the household was pregnant at the time of the Three Mile Island incident.
4. Whether there was a person below six years of age in the household.
5. The frequency with which the respondent consumed alcoholic beverages. (The assumption here is that high consumption of alcoholic beverages may indicate sensitivity to stress which leads to the consumption of alcohol (Chotlos and Deitler, 1959)).
6. Whether the respondent had experienced a life crisis other than Three Mile Island within the past year. The crises were taken from Holmes and Rahe's life events scale and included death of a family member or close friend, serious illness or injury, serious trouble with the law, loss of a job, divorce or separation, serious financial troubles or any other serious problem that was upsetting to the respondent (Holmes and Rahe, 1967).
7. Whether the respondent can, on a typical day, as he/she goes about his/her daily business at home or at work, see the Three Mile Island plant.
8. Whether the respondent describes him/herself as having any of the following personal traits:
 - a. is sensitive and introspective. (This measure has been reported to be associated with both psychological and somatic symptom reporting (Mechanic, 1979 and 1980)).

- b. has a tendency to complain about symptoms.
- c. rates his/her general level of health as poor rather than good.
- d. says he/she is a person who gets upset often.

Method and Results

Multiple regression analysis was utilized to analyze the relationships between 1) distress (upset, concern about safety and attributing symptoms to TMI) and 2) demographic variables, coping, sensitivity to stress and social support. Analyses were carried out in four steps. First the relationships between demographic variables (age, sex, education, income and marital status) and the three distress measures were studied. Second, relationships between the seven coping strategies and the three distress measures were assessed holding constant (i.e. controlling for) demographic variables. Third, relationships between the six social support and social roots measures and the three distress measures were assessed holding demographic variables constant. Fourth, relationships between the thirteen sensitivity measures and the three distress measures were assessed again holding constant demographic variables. In each of the above analyses, relationships to distress in July were studied as well as relationships to change in distress from July to January.

Results

Relationships between the demographic variables and three dependent variables in April, 1979 are reported in Table 5. Results show that younger persons, women and more highly educated persons were most upset during the crisis in March and April of 1979. Married persons were more distressed and single persons were less distressed than widows, separated or divorced persons. Thus the rank ordering of distress for the three marital status groups was: married persons most distressed; widowed, separated or divorced intermediate; and single persons least distressed. It is interesting to note that women were more likely than men to report symptoms which they

attributed to TMI. However, since females generally report higher symptom rates than males in surveys of this type, this finding may not be indicative of feelings about Three Mile Island. Several of the results in Table 5 are different from those commonly reported, namely that younger, more educated, married persons experienced the most stress. Most studies of symptom reporting have found the opposite. This is likely due to some unique features of the Three Mile Island crisis: the technical nature of the problems which would have had more meaning for more educated persons and the fact that persons in the child bearing stage are most likely to experience the effects of radiation to either themselves or their offspring.

Table 6 shows that change in distress from April to January is related to only one demographic variable: age. Since this is one out of 18 relationships studied, it is likely that this finding is due to chance. Our conclusion is that, while a number of demographic variables are related to distress during the crisis, they are not related to change in distress over time.

TABLE 5

RELATIONSHIPS BETWEEN DEMOGRAPHIC VARIABLES AND DISTRESS IN APRIL, 1979

(Only statistically significant relationships shown.
Direction of relationships shown by sign.)

	upset	worry about safety	attribute symptoms to TMI
age	-	-	
sex*	-	-	-
education	+	+	
married**	+	+	
single**		-	
income			

*Male is higher score.

**Compared to widowed, separated or divorced. Married and single are higher scores.

A plus sign indicates that a higher score on the demographic variable is associated with being more upset during the crisis in April, 1979.

The above findings can be summarized as follows:

- 1) Younger people tended to be more upset and more worried about safety than older people.
- 2) Women tended to be more upset, more worried about safety and more likely to attribute symptoms to TMI than men.
- 3) Higher educated people tended to be more upset and more worried about safety than lower educated people.
- 4) Married people tended to be more upset and more worried about safety than widowed, separated, or divorced persons.
- 5) Single persons tended to be less worried about safety than widowed, separated, or divorced persons.

TABLE 6

RELATIONSHIPS BETWEEN DEMOGRAPHIC VARIABLES AND CHANGE

IN DISTRESS FROM APRIL 1979 TO JANUARY 1980

(Only statistically significant relationships shown. Direction of relationship shown by sign.)

	change in upset	change in worry about safety	change in attribute symptoms to TMI
age			+
sex*			
education			
married**			
single**			
income			

*Male is higher scored.

**Compared to widowed, separated or divorced

A plus sign indicates that a high score on a demographic variable is associated with either maintaining high levels of distress and/or with increasing distress over the 9 month period from April 1979 to January 1980. Blanks indicate that there was no statistically significant relationship.

Relationships between coping strategies and distress during the crisis (with demographic variables held constant) are reported in Table 7. There is a strikingly consistent pattern to these findings: persons who were most distressed during the crisis used more coping strategies. Furthermore, Table 8 shows that, for 11 of the 21 relationships studied, persons who stayed upset through the nine month period from April 1979 to January 1980 were also more likely to be active copers.

This finding that most people who used coping strategies remained upset could be due to the unresolved nature of the Three Mile Island Crisis. As explained above, problems at the facility were continually in the news during the nine month period from April to January and groups for or against re-opening the facility attracted a good deal of public attention. Under these circumstances coping did not change the situation and, as a result, people who tried to cope may have felt particularly frustrated. This would be especially true for persons who use political actions as a coping device.

TABLE 7

RELATIONSHIPS BETWEEN COPING STRATEGIES AND DISTRESS IN APRIL

(Only statistically significant relationships shown.
Direction of relationships shown by sign.*)

	upset	worry about safety	attribute symptoms to TMI
avoidance coping strategies	+	+	+
social coping strategies	+	+	+
change use of milk	+	+	+
kept family inside	+	+	+
evacuated during crisis	+	+	+
participated in political activity re: TMI	+	+	+
took tranquilizers during crisis	+	+	+

*Plus sign indicates that persons who used that coping strategy were more distressed during the crisis in April 1979.

Age, sex, education, income and marital status have been controlled for in these analyses.

TABLE 8

RELATIONSHIPS BETWEEN COPING STRATEGIES AND CHANGE
IN DISTRESS FROM APRIL TO JANUARY

(Only statistically significant relationships shown.
Direction of relationships shown by sign.)*

	change in upset	change in worry about safety	change in attribute symptoms to TMI
avoidance coping strategies	+	+	
social coping strategies	+		
change in use of milk		+	+
kept family inside			
evacuated during crisis	+	+	
participated in political activity re: TMI	+	+	
took tranquilizers during crisis		+	+

*A plus sign indicates that persons who used that coping strategy tended to remain distressed and/or to increase distress over the 9 month period from April 1979 to January 1980. A blank indicates that there was no statistically significant relationship.

Age, sex, education, income and marital status have been controlled for in these analyses.

Relationships between social support and distress measures as well as between community roots and distress measures, with demographic variables held constant are reported in tables 9 and 10. These results are less consistent than those found for coping behaviors. Availability of help is associated with fewer attributed symptoms during the crisis and having more friends is associated with decreasing upset and worry about safety from the July to January surveys. These findings are consistent with the hypothesis that social support helps to buffer the effects of stressful experiences. However, only three out of twelve relationships were statistically significant. Therefore, the overall pattern of findings provides only weak support for the social support hypothesis. Findings for "community roots" variables are contradictory. Home ownership is associated with higher upset at the time of the crisis as well as remaining upset through January. Church attendance, on the other hand, is associated with lower upset scores during the crisis. Overall, the findings in tables 9 and 10 do not give strong support for either social support or community roots having a major effect in moderating stress during and after the TMI crisis.

TABLE 9

RELATIONSHIPS BETWEEN SOCIAL SUPPORT/COMMUNITY ROOTS AND DISTRESS IN APRIL

(Only statistically significant relationships shown.
Direction of relationships shown by sign.*)

	upset	worry about safety	attribute symptoms to TMI
<u>Social Support</u>			
number of friends			
availability of help			-
<u>Community Roots</u>			
length of residence			
own home or rent (own home high score)	+		
frequency of church attendance	-		
Pennsylvania Dutch			

Relationships control for age, sex, education, income and marital status.

*Minus sign indicates that more social support is associated with less distress.

The above findings can be summarized as follows:

- 1) Those with help available attributed symptoms to TMI less often than those without help available.
- 2) Home-owners tended to be more upset than renters.
- 3) Church-goers tended to be less upset than non-church-goers.

TABLE 10

RELATIONSHIPS BETWEEN SOCIAL SUPPORT/COMMUNITY ROOTS
AND CHANGE IN DISTRESS FROM APRIL TO JANUARY

(Only statistically significant relationships shown.
Direction of relationships shown by sign.*)

	change in upset	change in worry about safety	change in attribute symptoms to TMI
<u>Social Support</u>			
number of friends	-	-	
availability of help			
<u>Community Roots</u>			
length of residence			
own home or rent (own home high score)	+		
frequency of church attendance			
Pennsylvania Dutch			

Relationships control for age, sex, education, income and marital status.

*A minus sign indicates that persons with social support tended to decrease their stress from April to January.

The above findings can be summarized as follows:

- 1) People with more friends tended to decrease how upset they were and how much they worried about their safety more than those with fewer friends.
- 2) Home-owners tended to stay upset more than did renters.

The relationships between sensitivity variables and distress in April 1979 are reported in Table 11. A consistent pattern is apparent here with distress in July related to four sensitivity measures: 1) chronic illness (both physical and mental), 2) being frequently upset, 3) being in poor health, 4) being sensitive and introspective. One interpretation of these findings is that poor physical and mental health may predispose an individual to emotional distress during the crisis. However, an alternate explanation is suggested by the parallel finding that being sensitive and introspective relates to distress. Mechanic (1979 and 1980) has reported that persons who score high on the introspection scale also tend to report high levels of psychological and somatic symptoms. He has suggested that this may be because sensitive, introspective people focus attention on bodily sensations which, in turn, helps them to remember their symptoms. These sensitive, introspective persons may report more health problems before the crisis because of their tendency to focus attention on bodily sensations. They may report distress after the crisis for the same reasons. If this were so, the relationship between poor health before the crisis and distress after the crisis could be due to being sensitive and introspective rather than because health problems make one sensitive to stress. Unfortunately, correlational data, of the sort reported here, do not allow us to select between these two explanations. We can only say that the correlations are consistent with both explanations. This issue will be discussed further in Chapter 7.

Table 12 shows that three sensitivity variables relate to change in distress from April 1979 to January 1980: chronic physical problems, poor general health and introspection. While there are not as many significant findings as in Table 11, all relationships are in the predicted direction: greater sensitivity is associated with continuing distress.

There are two surprising findings in tables 11 and 12: 1) lack of relationships between distress and having family members below 6 years old and 2) the lack of relationships between distress and having a pregnant person in the household. These findings are somewhat surprising since these families were advised to evacuate during the crisis and considerable attention was given by the media to possible radiation effects on children and fetuses. To understand these findings it should first be noted that respondents with children under 6 or a pregnant person in the household were mostly young and married. We know from table 5 that young married people were among those most upset by the crisis. Results reported in tables 11 and 12 (where age and sex are controlled) indicate that having a child under 6 or pregnant person in the household did not add additional distress beyond being young and married. It is likely that young, married persons without children viewed themselves as potential childbearers and therefore were as upset as were young married persons with children.

TABLE 11

RELATIONSHIPS BETWEEN SENSITIVITY TO STRESS AND DISTRESS IN APRIL

(Only statistically significant relationships shown.
Direction of relationships shown by sign.*)

	upset	worry about safety	attribute symptoms to TMI
Chronic physical problems	+		+
Chronic mental problems	+	+	+
Frequency of alcohol consumption prior to TMI			
Gets upset often	+	+	+
Life stress problems in past year			
Poor general health	+	+	+
Express feelings openly	+		
Tendency to complain			
Sensitive, introspective person	+	+	+
See towers from home		+	
See towers from work			+
Family members below 6 years old			
Persons in household pregnant during crisis			

*A plus sign indicates that persons who had high vulnerability scores tended to be distressed.

Relationships have controlled for age, sex, education, income and marital status.

TABLE 12

RELATIONSHIPS BETWEEN SENSITIVITY TO STRESS AND CHANGE IN DISTRESS FROM APRIL TO JANUARY.

(Only statistically significant relationships shown.
Direction of relationships shown by sign.)*

	change in upset	change in worry about safety	change in symptoms attributed to TMI
Chronic physical problems			+
Chronic mental problems			
Frequency of alcohol consumption prior to TMI			
Gets upset often			
Life stress problems in past year			
Poor general health	+	+	+
Express feelings openly			
Sensitive, introspective person	+		
See TMI towers from home			
See TMI towers from work			
Family members below 6 years old			
Person in household pregnant during crisis			

*A plus sign indicates that persons who had high sensitivity scores tended to remain distressed from April to January.

Relationships have controlled for age, sex, education, income and marital status.

Summary

There is evidence that persons who are younger, more educated, married and female were especially distressed during the crisis. However, these demographic variables did not relate to change in distress over time. People who actively coped had high distress during the crisis and tended to maintain that distress over time, possibly because the situation at TMI remained unresolved and their attempts at coping resulted in frustration. There were only a few indicators that social support may have helped to moderate distress during and after the crisis. Finally, persons with poor mental or physical health or a tendency toward self-attention and evaluation tended to have high distress scores and to maintain their distress over the nine month period from April 1979 to January, 1980. One possible explanation for this finding is that people with poor physical or mental health were more vulnerable to the stress of Three Mile Island. However, there are alternate explanations for these findings and it is not possible, with the data available in this study, to determine which explanation is correct.

-1-

Chapter 7

SUMMARY OF FINDINGS RELEVANT TO PUBLIC POLICY

The purpose of this chapter is to summarize the main findings reported in earlier chapters with special attention to those which have implications for public policy. Also included are qualifications which should be considered in any practical application of these findings. We recognize that public policy decision-making involves a broad range of issues, one of which may be social science research findings. It is not our intention, therefore, to make recommendations for specific actions by public officials but, rather, to report clearly and carefully findings which may be of use to them in the complex process of developing public policy.

Before reviewing specific findings, one general qualification should be made which applies to most findings reported here. Subjective, introspective reports, which constitute the bulk of data analyzed here, are vulnerable to selective memory and conscious as well as unconscious distortions. Usually these distortions are in the direction of making respondents appear more positive to themselves and others or of making past experiences consistent with present feelings. Certain descriptive facts, i.e. age, sex, education, etc. are most likely correct, but recollections where feelings are strong and where memory is long are especially vulnerable to distortion. For this reason it is best to look for patterns which are repeated across measures and across studies. This has been the approach used in presenting findings of this study and will be the basis for the summary statements made in this chapter.

FINDINGS CONCERNING EVACUATION

Data from questionnaires and in-depth interviews indicate that, in most decisions to evacuate, the primary reasons were because the situation seemed

dangerous and/or that information about the situation was confusing. Primary reasons for not evacuating were that respondents either saw no danger or because they perceived some danger but felt constrained to stay because of such things as being unable to leave the job, too sick to travel, etc.. Interview data indicated that the decision whether or not to leave was based on an evaluation of the information available from the media and that mass panic (in the sense of people responding to other people's emotional states rather than to information about the situation) did not occur.

Generalizations relevant for public policy included the following:

- 1) Information conveyed by the media was the main basis for decision to evacuate. Two aspects of this information were especially important in the decision to evacuate:
 - a) information about possible danger
 - b) inconsistencies and/or contradictions in information.
- 2) There was considerable variability among residents in how information was interpreted resulting in:
 - a) evacuation and returning being spread over a considerable period of time which contributed to the efficiency with which the large number of people evacuated the area
 - b) a substantial percentage of the population electing not to evacuate at all

It should be pointed out that the above conclusions are based on retrospective questionnaire and interview data. Therefore, bias may

be introduced through respondents trying to appear more rational than they were during the crisis or due to distorting memories so as to be consistent with feelings at the time of the interview.

FINDINGS CONCERNING DISTRESS CLOSE TO TMI COMPARED TO FARTHER AWAY

Four measures of distress were studied: 1) how upset respondents felt about Three Mile Island, 2) how worried they were about the safety of themselves and their families, 3) whether they reported any of 15 stress-related symptoms in a two week period, and 4) responses to the Langner scale of psychological distress.

Results from the questions about being upset and worried about safety show that 1) from April to January 1980 there was a 50% drop in number of people quite distressed about TMI and 2) in both April 1979 and January 1980 persons close to Three Mile Island were more distressed than were persons farther away.

Findings for the 15 stress-related symptoms showed a similar pattern to the questions about being upset and worried. Results showed that symptom reporting was significantly higher close to Three Mile Island farther away for the two weeks immediately following the accident in March 1979, the first two weeks in July 1979 and two weeks in January, 1980. For all three time periods, reporting rates were raised between 10 and 20% close to TMI compared to 40 to 55 miles away.

Results with the Langner scale of psychological distress, which was administered only in January, showed no significant differences between those close and far from Three Mile Island.

The above findings should be carefully qualified in considering their relevance for public policy. First, all of this information was obtained in the context of an interview about Three Mile Island which may have

affected respondents' expectations of what they should say. Second, symptom reporting, as explained in detail in Chapter 5, are susceptible to many factors in addition to actually having symptoms. Therefore, we cannot be certain that people close to Three Mile Island experienced more stress-related symptoms than did people farther away. It could be for example, that people close to TMI paid special attention to their symptoms (wondering if they were due to TMI) which could help them to remember those symptoms. This interpretation is consistent with the finding that a higher percent of persons close to TMI attributed their symptoms to TMI than did persons farther away. Unfortunately, the self-report, retrospective data available do not allow us to choose between these alternate explanations.

The fact that, in January, the Langner scale scores did not change with distance has implications for understanding the type and severity of distress experienced. The Langner scale was originally designed to differentiate persons in mental health treatment from the general population. This suggests that the distress characteristic of mental patients was not higher close to TMI in January. However, there is an important qualification to this statement. The Langner scale questions deal primarily with depressive symptoms and psychosomatic symptoms. Other areas of mental health are either not represented or only peripherally represented.

A detailed analysis of items in the Langner and in the stress-related symptom list was helpful in understanding the type and severity of distress close to TMI in January, 1980. A comparison of items in the two scales shows that the Langner scale asks about more frequent symptoms than does the stress related symptom list. For example, the Langner scale asks whether respondents had headaches often and the stress-related symptom list asks only if respondents had a headache in the past two weeks.

Another difference between the two scales, which may have contributed to their different results, is that the Langner scale includes questions about psychological mood not included in the stress-related symptom list.

The above findings regarding stress close to TMI can be summarized as follows: The number of persons with severe distress dropped shortly after the crisis, but between 10 and 20% of respondents close to TMI remained sufficiently distressed nine months after the crisis to say that they were still quite upset about the situation, that they were still quite worried about the safety of themselves and their families and to report higher frequencies of stress-related symptoms. On the other hand, it should be noted that the type and frequency of these symptoms were different from the type and frequency of symptoms assessed by the Langner scale.

There are two important qualifications which should be made to the above conclusion. First, all these data are subjective and retrospective and therefore vulnerable to conscious and unconscious distortion. In view of the fact that some persons near Three Mile Island are suing for damages because of alleged mental distress, the possibility of conscious distortion should be considered. Second, comparisons between persons close to TMI with persons farther away only shows differences between the two groups and does not include distress due to TMI felt by groups far away. Therefore, these estimates of distress near Three Mile Island may be conservative.

The above findings are consistent with reports by two other investigatory groups. The Task Force on Behavioral Effects of the Presidential Commission on Three Mile Island reported that scores on the "Demoralization Scale," were raised immediately following the crisis period but had dropped to the point where they were not different from a control group over 100 miles away by July. The demoralization scale and the Langner scale are highly correlated and even include some of the same questions. Therefore, the findings with

the Langner scale in January, 1980 replicate and extend the findings with the Demoralization scale in July, 1979. The Presidential Commission task force also reported that distrust of authority remained elevated in July, 1979. Dr. Evelyn Bromet (Bromet, 1980) has also reported elevated scores on a 90 item symptom checklist for mothers of young children near TMI in December 1979 compared to mothers of young children near another nuclear power station several hundred miles away. The severity of this heightened distress is not discussed in sufficient detail in Dr. Bromet's preliminary report to allow comparisons to the two scales used in our studies, but her finding does indicate some persistence of distress into December 1979.

FINDINGS REGARDING LEVELS OF ALCOHOL, TOBACCO,

SLEEPING PILLS AND TRANQUILIZERS USE.

Responses to the July survey suggests that persons close to TMI used more alcohol, tobacco, sleeping pills and tranquilizers during the two week period immediately following the crisis than they did in July, three months later. When many of these respondents were re-interviewed in January, 1980, the use of these substances was essentially the same as that in July. Respondents who used tobacco and alcohol were asked if their use of these substances had increased, decreased or remained the same in the nine months since the Three Mile Island crisis. Approximately equal numbers reported increases as decreases with most respondents reporting no change. These findings suggest that the use of alcohol, tobacco, sleeping pills and tranquilizers increased only during the crisis period and did not persist beyond that time.

These conclusions also should be qualified since sleeping pill and tranquilizer users were not asked in January if their use had changed since TMI. Furthermore, all data are subjective and retrospective and therefore subject to conscious and unconscious distortion.

FINDINGS CONCERNING HOW DEMOGRAPHIC CHARACTERISTICS RELATE TO
INITIAL DISTRESS AND CHANGE IN DISTRESS OVER TIME.

Persons who were younger, married, higher educated and female reported more distress during the crisis period than did older, single, less educated males. The greater responsiveness of younger, married persons was possibly due to their concerns about the effects of radiation on their present and future children and, since radiation effects often have a long latency, concerns about their own future health. More educated persons were more upset possibly because of greater knowledge of the effects of radiation and the technical problems at the Three Mile Island facility. The male-female difference is consistent with many other studies in which females have reported higher distress and more symptoms than men. The reasons for this sex difference may include greater willingness to acknowledge feelings on the part of women, a greater sensitivity to stressful situations on the part of women, or in the case of the Three Mile Island crisis, the fact that pregnant women and mothers of young children were told to evacuate. The fact that being pregnant or having young children did not increase distress beyond the effects of being young and married was possibly due to the fact that most young, married persons considered themselves potential child-bearers. Again, the subjective, retrospective nature of the distress measures should be considered in generalizing from these findings.

FINDINGS CONCERNING HOW COPING RELATES TO INITIAL
DISTRESS AND CHANGE IN DISTRESS OVER TIME

All measures of coping were associated with at least one distress measure during TMI and all but one measure is associated with change in distress over time. The consistency of these results are striking, indicating that people

who did things to actively cope with their feelings or the external situation were more upset and remained upset over the 9 months following the crisis. It is likely that, in this situation, coping was more a response to stress than a way to change stress. This may be due to the persistence of problems at Three Mile Island and feelings of frustration in trying to control one's own feelings or the objective situation.

A qualification to these findings is that coping may have helped people remember distress. In other words, people who tried to control distress may be more likely to remember being distressed than people who gave up and didn't try to do anything about their distress. This explanation implies that selective memory may also account for those findings. This and other retrospective distortions could have been involved in the relationships that were found.

FINDINGS CONCERNING HOW SOCIAL SUPPORT RELATED TO INITIAL
DISTRESS AND CHANGE IN DISTRESS

There were a small number of significant findings in analyses of relationships between social support/social roots and distress. The number of statistically significant relationships was not large and direction of relationships was not always consistent. The overall pattern of these findings provides little indication that social support or community roots helped to buffer the stress experiences during and after the crisis.

FINDINGS CONCERNING HOW VULNERABILITY RELATES TO INITIAL
DISTRESS AND CHANGE IN DISTRESS

A consistent pattern emerged from these analyses indicating that persons who report a history of physical or mental health problems are more likely

than others to report higher distress during the crisis period and to maintain that distress over the 9 months from April 1979 to January, 1980. This suggests that persons with serious health problems may have been especially responsive to the stress of the Three Mile Island crisis. However, there is an alternate explanation suggested by the parallel finding that "sensitive introspective" people tended to have and maintain high distress. Since the "sensitive and introspective" scale has been shown in other studies (Mechanic 1979 and 1980) to be related to both mental and somatic symptom reporting, it is likely it plays a role in the associations between health ratings and distress. If so, it may be that people who attend to and focus on health problems (i.e. sensitive, introspective people) are more likely to remember symptoms before as well as after the crisis. If this were the case, the association between health ratings before TMI, and distress during the crisis would be because people who paid attention to bodily states before the crisis did so during the crisis as well and not because sickly people are responsive to stress.

Competing explanations, similar to the ones above, are possible for most of the findings presented in this report. This is partly the result of having to rely on subjective, retrospective data and partly it is because of having incomplete data about a complex situation. We feel that it is important that the public and the makers of public policy understand not only the findings of this study, but also the many interpretations that are possible. Only with this full understanding can these findings be meaningfully related to public policy.

RECOMMENDATIONS FOR RESEARCH ON FUTURE CRISES

As explained above, we do not feel it is not appropriate for us, as researchers, to make policy recommendations concerning the situation at Three Mile Island. However, we do feel qualified to make recommendations in the area of research. Our experience in designing, and carrying out research on Three Mile Island leads us to make the following recommendations for carrying out similar studies in the future.

- 1) In this study we had to rely on retrospective reports of how people felt and behaved during the crisis. As explained earlier, retrospective data is vulnerable to many types of distortion which could have been avoided with data collected during the crisis period. We therefore recommend that governmental and private groups concerned with the effects of disasters make funds available which could be used immediately so as to begin data collection while crises are still in progress.
- 2) When this study was being planned, in April and May 1979, other investigators were planning similar studies. Several people commented, at that time, that there was "overlap" and "duplication" in these studies implying that this was undesirable. On the contrary, we have found, in the year and a half since this work was begun, that it has been of great value to have several independent investigators studying the effects of the Three Mile Island crisis. Each study has had limitations, e.g. populations sampled, time of sampling, questions asked, etc. but, by noting consistencies and inconsistencies across studies it has been possible to identify patterns which support or do not support specific findings in any one study. It has also been possible to identify patterns across studies which have gone beyond what could be learned from any one study e.g. the relationships between

short term stress demonstrated in the studies by the Presidential Commission and long term stress reported here and in Dr. Bromet's research. Our recommendation, therefore, is that, in studying future crises, that several independent investigators be involved.

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This report was prepared by the Department of Behavioral Science of The Pennsylvania State University College of Medicine, The M.S. Hershey Medical Center, Hershey, PA. 17033.

HEALTH-RELATED BEHAVIORAL IMPACT OF
THE THREE MILE ISLAND NUCLEAR INCIDENT

PART III

Peter S. Houts, Ph.D.* Principal Investigator

Renee M. DiSabella, B.S.*
Marilyn K. Goldhaber, M.P.H.**

Report Submitted to the TMI Advisory Panel
on Health Research Studies

of

The Pennsylvania Department of Health

*Department of Behavioral Science
Pennsylvania State University College of Medicine
Hershey, PA

**Division of Epidemiological Research
Pennsylvania Department of Health
Harrisburg, PA

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ABSTRACT

A telephone survey of households within 5 miles of TMI and a group from 41-55 miles from TMI was conducted in October, 1980. Three questions were addressed. 1) Had distress levels in the 5 mile radius changed in comparison to earlier studies? 2) How did respondents feel about the situation at Three Mile Island and how it was being handled? 3) How did respondents react to the venting of Krypton gas at TMI in July of 1980.

Distress

Five distress measures were repeated from earlier surveys, thus allowing comparisons over an 18 month period from April, 1979 to October 1980. The five measures were: being upset about TMI, feeling TMI was a threat to safety, reporting of stress related symptoms (2 clusters of symptoms: somatic and behavioral) and, for those respondents who had symptoms, whether they attributed the symptoms to Three Mile Island. Results showed reductions in distress for both the close and far groups over the 18 month period studied. There was a sharper rate of reduction for the group close to TMI than for the group 41-55 miles away. The 0-5 mile group had significantly higher distress than the 41-55 mile group on all measures through January, 1980 but, in October, 1980, differences were no longer statistically significant for stress-related symptoms and for ratings of upset regarding TMI.

(Abstract Continued)

Attitudes

Opposition toward re-starting unit number one at TMI dropped from 60% in January, 1980 to 47% in October, 1980 for the group within 5 miles of TMI. The Nuclear Regulatory Commission and energy experts working for the Pennsylvania Department of Environmental Resources were given the most support for having a say in how the TMI clean-up is carried out. Respondents in both groups were fairly evenly distributed as to whether to have more or fewer nuclear plants in the future. When asked how much they believed in rumors regarding effects of TMI (e.g., rumors of increased miscarriages, increased cancer rates, increase in mental health problems, etc.) respondents were approximately equally distributed between believing and not believing rumors with a tendency for more people to believe than disbelieve the rumors. For two of the rumors, (an increase in miscarriages and an increase in birth defects) there was greater acceptance of the rumor in the 41-55 mile group than in the 0-5 mile group. Respondents' ratings of media coverage of the TMI situation showed that almost half of the respondents felt the media had blown events and of proportion, approximately 20% thought information had been withheld and less than 1/3 thought that events were reported accurately.

Reactions to Krypton Venting

Fifteen percent of respondents within 5 miles of TMI said that they left the area during the venting and that the venting was an important reason for their leaving. The average length of absence due to venting was 10 days. Attitudes toward the venting were significantly more positive among persons close to TMI than among persons in the 41-55 mile group.

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INTRODUCTION

Several studies of the psychological, social and economic effects of the Three Mile Island nuclear accident have been conducted since the crisis in March, 1979. One of these studies, (Houts et al, 1980) carried out by the Pennsylvania State University under auspices of the Pennsylvania Department of Health, showed heightened distress levels near the facility that persisted through January, 1980. Subsequent reports by Bromet (1980) and Bromet and Dunn, (1980) came to similar conclusions, namely, that the population close to Three Mile Island contained many people who were very concerned about the situation there and who also reported heightened levels of symptoms frequently associated with stress for as long as a year after the original crisis.

The present study, carried out in October, 1980, eighteen months after the original crisis, had two purposes:

- 1) to determine whether distress levels and concerns shown to be elevated close to TMI had changed in the nine months since the Department of Health Survey in January, 1980.
- 2) to obtain attitudes and opinions on a variety of issues germane to the situation at Three Mile Island which had not been investigated earlier. These issues included rumors about bad effects of the nuclear accident, what groups should influence how TMI is cleaned up, media coverage, the future use of nuclear power plants in this country, and scientists' knowledge of radiation.

METHOD

This study was carried out in conjunction with a study of mobility of persons living within 5 miles of Three Mile Island (Goldhaber et al, 1981). The report of that study contains detailed information about sample selection and interview

techniques. Following is a summary of those aspects of the methodology most relevant to this study.

Sample Selection Two groups were studied: 100 respondents living from 41 to 55 miles from Three Mile Island and 400 respondents living within five miles of TMI in October, 1980. Respondents from 41 to 55 miles away were selected in the same manner as in the Nuclear Regulatory Commission Survey in July, 1979 (Flynn, 1979) and in the Pennsylvania Department of Health survey in January, 1980 (Houts et al, 1980). This made it possible to compare responses from this study to those from the earlier studies. The sample of persons living within 5 miles of Three Mile Island was constructed from two sub samples of the mobility study: 1) persons who were living within five miles of TMI at the time of the Pennsylvania Department of Health census in August, 1979 and who had not moved from their dwellings since that time and 2) persons who had moved into dwellings within 5 miles of TMI during the year following the census. Since there were a larger number of in-migrants in relation to non-migrants in these samples than in the general population, weighting was used to obtain responses characteristic of the general population.*

Telephone interviews were carried out with all groups by Chilton Research Services of Radnor, Pennsylvania. Respondents in the 41-55 mile group were selected using random digit dialing while respondents within 5 miles of Three Mile Island were selected either from Department of Health census lists for the area or, for in-migrants, lists of persons who moved into vacated dwellings or new housing since the TMI crisis. (See Goldhaber et al, 1981 for detailed description of sample selection.)

*Weightings used in the calculations for the 0-5 mile group were based on a mobility rate of 12.5%. After these calculations were completed it was determined that the mobility was actually 11.6%. In order to determine whether new calculations were required, the mean, standard deviation, mode and median were computed for demographic variables (age, sex, education, income, and marital status) using the 12.5% weighting and the 11.6% weighting for in-migrants as compared to non-migrants. The results, shown in appendix III show almost identical results with the two weightings. It was therefore decided not to re-compute other analyses.

DISTRESS INDICES

Both of the earlier surveys (July, 1979 and January, 1980) showed heightened distress near Three Mile Island compared to farther away. The same distress indices used in earlier studies were included in the present study to determine whether this pattern persisted for an additional 9 months (or 18 months after the original crisis). In the July, 1979 and January, 1980 surveys distress was measured at all distances out to 55 miles from TMI. However, the present study only sampled within the 5 mile radius and between 41-55 miles from TMI. Therefore, to make the results of these studies equivalent, data from the earlier studies were re-analyzed to compare just the group within 5 miles of TMI to the group between 41 and 55 miles away. Analysis of covariance was utilized controlling for age, sex, education, marital status and income. Results for the five distress indices for the four time periods after the TMI crisis are shown in Table 1. The overall pattern is quite interesting. Three of the measures which had indicated higher distress close to TMI compared to farther away in April, 1977, July, 1979 and January, 1980, no longer showed statistically significant differences in October, 1980. On the other hand, the three other distress measures are significantly different at all four time periods.

1. Upset ratings were significantly higher close to TMI compared to far away from April, 1979 through January, 1980, but were no longer statistically different in October, 1980. An examination of the mean ratings at each time period shows that levels of upset came down over time for both the close and far groups, but that the drop was sharper for the groups close to TMI.
2. Both behavioral and somatic symptoms were reported more frequently close to TMI compared to 41-55 miles away in April and July 1979 as well as in January 1980. However, by October,

1980, this difference was sharply reduced and the difference between the two groups was no longer statistically significant. It should be noted that the general levels of symptom reporting fluctuated considerably over this time period. This could have been due to many factors including seasonal variations. Therefore, general levels of reporting are not necessarily indicators of the effects of TMI, while differences between the close and far groups are.

3. Perceptions of TMI as a serious threat to one's family's safety came down over time for both the close and far groups, though, as with ratings of upset, the drop was sharper for respondents within 5 miles of TMI. Nonetheless, the differences between the close and far groups was still statistically significant in October, 1980.
4. The attribution of symptoms to Three Mile Island, which involved only respondents who reported behavioral or somatic symptoms, dropped sharply for both groups during the 15 months studied, but, as with perception of threat, attribution was still significantly higher close to TMI in October, 1980.

The overall pattern of these findings shows reductions in distress for both the close and far groups over the 18 month period studied. There was a sharper rate of reduction for the group close to TMI than far away. Differences between the close and far groups persisted through October, 1980 for perceived threat and for attributed symptoms, but dropped to non-significance in October 1980 for ratings of upset and for number of persons reporting behavioral or somatic symptoms.

TABLE 1: MEAN DISTRESS SCORES FOR PERSONS LIVING EITHER WITHIN 5 MILES OF TMI OR BETWEEN
41 AND 55 MILES AWAY FROM TMI AT FOUR TIME PERIODS

<u>DISTRESS MEASURES</u>					
Distance from TMI (miles)	Upset about TMI ¹	TMI a Serious ₂ Threat	Behavioral Symptoms ³	Somatic Symptoms ⁴	Attributed Symptoms to TMI ⁵
<u>April 1979***</u>					
Within 5	3.36	3.10	.30	.18	.69
41-55	<u>2.21</u>	<u>2.13</u>	<u>.07</u>	<u>.05</u>	<u>.29</u>
Difference	1.15**	.97**	.23**	.13**	.40**
<u>July 1979</u>					
Within 5	+	3.16	.32	.37	+
41-55	+	<u>2.46</u>	<u>.17</u>	<u>.21</u>	+
Difference		.70**	.15**	.16**	
<u>January 1980</u>					
Within 5	2.59	2.39	.40	.51	.25
41-55	<u>1.95</u>	<u>1.60</u>	<u>.18</u>	<u>.35</u>	<u>.04</u>
Difference	.54**	.79**	.22**	.16*	.21**
<u>October 1980</u>					
Within 5	2.32	2.11	.40	.42	.28
41-55	<u>2.14</u>	<u>1.68</u>	<u>.40</u>	<u>.38</u>	<u>.12</u>
Difference	.18	.43**	.00	.04	.16*

Effects of age, sex, education, marital status and income have been controlled.

1. How upset are/were you about TMI? Scale 1-5; 5 - Very upset, 1 - Not at all upset.
2. How serious a threat is/was TMI to family's safety? Scale 1-4; 4 - Very serious, 1 - Not at all serious.
3. Do/Did you have one or more of the following symptoms in the past 2 weeks (or, in the case of April, in the 2 weeks of the crisis): lack of appetite, overeating, sleeplessness, shakes, trouble thinking, irritability, or anger? 1- Yes, 0 - No.
4. Do/Did you have any one or more of the following symptoms in the past 2 weeks (or, in the case of April, in the 2 weeks of the crisis): stomachaches, headaches, diarrhea, frequent urination, rash, abdominal pain, sweating spells? 1- Yes, 0 - No.
5. Do you think your symptoms are due to TMI? 1 - Yes, 0 - No. (Only for persons reporting symptoms)

* Indicates that the difference between groups is significant at the $p < .05$ level.

** Indicates that the difference between groups is significant at the $p < .01$ level.

+ July 1979, data is not available for upset and attribution of symptoms.

*** Data for April, 1979 were collected in the July, 1979 survey and, therefore are retrospective.

ATTITUDES AND BEHAVIOR REGARDING THREE MILE ISLAND

Two questions concerning Three Mile Island were repeated from earlier studies, allowing comparisons over time. These will be discussed first. The first question concerned restarting reactor number one, the undamaged reactor, at Three Mile Island. Results, shown in Table 2 indicate that, in January, 1980, when the question was first asked, sixty percent of respondents close to TMI and thirty-one percent of respondents 41-55 miles away opposed re-starting the facility. In October, 1980, the percentages were much closer, with forty-seven percent of respondents within 5 miles of TMI opposing re-starting and forty-two percent of respondents living 41-55 miles away opposing restarting. The difference between the two groups was statistically significant in January, 1980, but was not so in October, 1980. It is interesting that both groups changed over time, but in opposite directions. However, when the changes of each group are tested statistically, the change close to TMI (from 60% to 47%) is statistically significant ($\chi^2 = 5.41$, $df=1$, $p < .05$) but the change in the 41-55 mile group is not ($\chi^2 = 2.63$, $df=1$, $p > .05$).

The second question repeated from earlier surveys concerned political activity and asked respondents whether they had, personally, been active in any organization or gone to any meeting to influence what happened at TMI. The results, shown in Table 3, indicate a slight increase from 13% to 15% among respondents within 5 miles of TMI and little change in the 41-55 mile group. As explained in an earlier report (Houts et al, 1980 part one) the participation rate near TMI is high by usual standards of political activity in this country. However, it has not increased substantially in the nine month period from January to October 1980, for either the group within 5 miles ($\chi^2 = .088$, $df=1$, $p > .05$) or the group living between 41 and 55 miles away ($\chi^2 = .007$, $df=1$, $p > .05$).

TABLE 2 : ATTITUDES TOWARD RE-STARTING TMI

<u>Position on re-starting undamaged reactor</u>	January 1980		October 1980	
	<u>within 5 miles</u>	<u>41 - 55 miles</u>	<u>within 5 miles</u>	<u>41 - 55 miles</u>
Support restart	17%	33%	37%	35%
Don't care or don't know	23%	36%	16%	23%
Against restart	60%	31%	47%	42%

TABLE 3 : PARTICIPATION IN ORGANIZATIONS OR ATTENDANCE AT MEETINGS
TO INFLUENCE WHAT HAPPENS AT TMI

January 1980		October 1980	
<u>within 5 miles</u>	<u>41 - 55 miles</u>	<u>within 5 miles</u>	<u>41 - 55 miles</u>
13%	0%	15%	1%

The remaining attitude questions had not been asked earlier and, therefore, data were only available for this survey. The first group of questions dealt with how much influence respondents felt different groups should have in decisions to clean up TMI. Respondents were asked if each of 8 groups should have "a lot" "some" or "no" influence in decisions to clean up TMI. Respondents were scored 1 = a lot, 2 = some, 3 = none. Don't know responses were assigned mean values. The 0-5 and 41-55 miles groups were compared utilizing analysis of covariance to control for age, sex, education, marital status and income. Results, shown in Table 4, indicate a relatively high level of support for all groups. Even the group with the lowest level of support, organized groups of citizens, received a mean value which indicated that they should have some influence. It is interesting that the highest ratings were given to the Nuclear Regulatory Commission and to energy experts working for the Pennsylvania Department of Environmental Resources (DER). It appears that the public prefers technical experts working under government auspices to have the most influence. Respondents in both groups agreed rather closely in their ratings, though the DER was ranked significantly higher by persons in the 41 to 55 miles group. However, it should be noted that both groups ranked the DER first.

TABLE 4: MEAN SCORES ON QUESTIONS CONCERNING THE INFLUENCE WHICH DIFFERENT GROUPS SHOULD HAVE IN DECISIONS TO CLEAN UP TMI FOR PERSONS LIVING EITHER WITHIN FIVE MILES OR BETWEEN 41 AND 55 MILES AWAY FROM TMI

<u>Questions</u>	<u>Mean Scores (Within 5 Miles)</u>	<u>Mean Scores (41 to 55 Miles)</u>	<u>Significance Of Difference</u>
In deciding how to clean up TMI how much influence should different groups have in determining how it's done. ¹			
Organized groups of citizens	1.98	1.97	n.s.
Energy experts from colleges, universities and other impartial organizations	1.78	1.80	n.s.
Decisions voted by the general public	1.75	1.76	n.s.
Elected local officials	1.86	1.94	n.s.
Metropolitan Edison Company	1.92	1.77	n.s.
Nuclear Regulatory Commission	1.54	1.42	n.s.
Energy experts working for the Pennsylvania Department of Environmental Resources	1.53	1.40	*
Elected state or federal officials	1.94	1.87	n.s.

Effects of age, sex, marital status, education and income have been controlled.

¹How much influence should each group have in decisions to clean up TMI? Scale 1-3.
1= A lot, 2 = Some, 3 = None

*The difference between groups is significant at the $p < .05$ level.

n.s. - The difference between groups is not statistically significant.

Response frequencies to each question are listed in detail in Appendix II.

Six attitude questions concerning belief in rumors were included in the October survey. Each rumor had received publicity during or after the crisis. Each rumor had also been shown to be either incorrect or else lacked objective verification. Responses were on a four point scale with 4 indicating disbelief and 1 definite belief. An "undecided" response was given a score of 2.5. The results, shown in Table 5, average close to 2.5. It is interesting to note that all of the means for the group from 41 to 55 miles from TMI were below 2.5, while only three out of six means were below 2.5 for the group close to TMI. Further, the two rumors where there was a statistically significant difference, (increased miscarriages, stillborns and infant deaths plus increased birth defects) showed greater acceptance of the rumors in the 41-55 mile group than in the 0-5 mile group. This suggests the hypothesis that the group farther from TMI was more willing to accept rumors than the group close to TMI. This hypothesis was tested by summing the six rumor scores for each respondent and testing whether the total rumor scores were different for the two groups. The analysis of covariance test was not statistically significant, thus the hypothesis of a difference in general acceptance of rumors is rejected.

The final attitude question dealt with media coverage of the TMI situation. Results, reported in Table 6, show that almost half of the respondents in both groups felt that the media had blown events out of proportion, and one in five thought that information was withheld or covered up. Less than one third felt that the events were reported accurately. It is interesting that the two groups had almost identical percentages for each response option.

TABLE 5: MEAN SCORES ON THE CREDIBILITY OF RUMORS ABOUT TMI
FOR PERSONS LIVING EITHER WITHIN 5 MILES OR BETWEEN 41 AND
55 MILES AWAY FROM TMI

<u>Items From the Survey</u>	<u>Mean Scores (Within 5 Miles)</u>	<u>Mean Scores (41 to 55 Miles)</u>	<u>Significance Of Difference</u>
I'm going to read some statements about TMI. Please tell how true you ¹ think each statement is.			
There has been an increase in the number of miscarriages, stillborns, and infant deaths since the TMI accident.	2.66	2.41	*
There has been an increase in birth defects in the area since the TMI accident	2.72	2.45	*
Cancer rates will increase because of TMI	2.35	2.34	n.s.
Farm animals in the area have had an increase in health problems since TMI	2.43	2.28	n.s.
There has been an increase in general health problems because of TMI	2.53	2.34	n.s.
There has been an increase in mental health problems because of TMI	2.21	2.28	n.s.

Effects of age, sex, education, marital status and income have been controlled.

¹All rumors were scored on a scale of 1-4. 4 = Rumor was definitely not true,
2.5 = Respondent was undecided, 1 = Rumor was definitely true.

*The difference between groups is significant at the $p < .01$ level.

n.s. The difference between groups is not statistically significant.

Response frequencies to each question are listed in detail in Appendix II.

TABLE 6: MEAN RATINGS OF MEDIA COVERAGE OF THE SITUATION AT THREE MILE ISLAND FOR PERSONS LIVING EITHER WITHIN 5 MILES OR BETWEEN 41 AND 55 MILES AWAY FROM TMI

	(Within 5 Miles)	(41 to 55 Miles)
What has been your impression of the way newspaper, television and radio has been reporting events at TMI?		
Blown events out of proportion	46%	46%
Reported events fairly accurately	28%	29%
Withheld or covered up information	22%	21%
Don't know	4%	4%

The difference between the two distance groups is not statistically significant (utilizing analysis of covariance controlling for age, sex, education, income, and marital status).

REACTIONS TO KRYPTON VENTING

Three questions were included in the October survey which dealt with how respondents felt about the venting of Krypton gas at Three Mile Island in July of 1980. The venting of this gas had been the subject of considerable public debate in the months prior to its occurrence. Partly as a result of this debate, the public was informed in advance of each venting. This gave persons living in the area an opportunity to evacuate during venting periods if they so wished. Data on who evacuated, when they left and for how long they stayed away was available for persons within five miles of TMI but not for the control group 41 to 55 miles away. Since the representative sample of persons living within 5 miles of TMI may have included some persons who moved into the area after the venting in July, 1979, estimates of evacuation may have been conservative. Results indicate that 15% of the population living within 5 miles of TMI in July, 1980 reported that the venting was an "important reason" for their leaving and an additional 4% said that it was a "somewhat important reason" for their leaving during that period. Furthermore, of those persons who reported that the venting was at least a somewhat or very important reason for leaving, 40% left before the venting began, 52% left in the first week of venting and 8% left in later weeks of venting. The average length of absence due to venting was 10 days.

Two attitude questions about the Krypton venting were asked of respondents within 5 miles of TMI in October, 1980 as well as the control group from 41-55 miles away. The results, shown in Table 7 are quite interesting. For both questions, persons living close to TMI were significantly less negative about the venting than were people living farther away.

TABLE 7: ATTITUDES TOWARD VENTING FOR PERSONS LIVING EITHER WITHIN 5
MILES OR BETWEEN 41 AND 55 MILES AWAY FROM TMI

	<u>0 - 5 Miles From TMI</u>	<u>41 - 55 Miles From TMI</u>
Do you think that venting was the right way to get rid of the Krypton gas or should they have gotten rid of it some other way?		
Should have vented	56%	40%
Used some other way	28%	33%
Don't know	16%	27%

The differences in the two groups' responses was statistically significant¹ ($p < .01$) indicating more support for venting in the 0-5 mile group compared to the 41-55 mile group.

	<u>0 - 5 Miles From TMI</u>	<u>41 - 55 Miles From TMI</u>
How dangerous do you think the krypton venting was?		
Dangerous	15%	13%
Somewhat dangerous	39%	55%
Not too dangerous	23%	15%
Not at all dangerous	18%	9%
Don't know	5%	8%

The difference in the two groups responses was statistically significant¹ ($p < .01$) indicating lower ratings of danger for the 0-5 mile group compared to the 41-55 mile group.

¹ Utilizing analysis of covariance where age, sex, education, marital status and income have been controlled.

GENERAL ATTITUDES

Two questions dealt with general attitudes toward nuclear energy. The first question asked how much scientists know about radiation and the second asked if there should be more, the same or fewer nuclear plants in the future. The results, shown in Table 8, show no statistically significant differences between the two groups on either question. The averages for these questions indicate that the public tends to take a middle position on both issues. Respondents perceived scientists as knowing between "something" and "a great deal" about radiation and they tend to favor the same number of nuclear plants in the future as now.

TABLE 8: GENERAL ATTITUDES TOWARD NUCLEAR ENERGY FOR PERSONS LIVING
WITHIN 5 MILES OR BETWEEN 41 AND 55 MILES FROM TMI

	<u>0 - 5 Miles From TMI</u>	<u>41 - 55 Miles From TMI</u>
Do you think, in the future, this country should have		
More nuclear power plants	28%	36%
The same number as now	29%	28%
Fewer nuclear power plants	40%	31%
Don't know	3%	5%

The difference between the two groups' responses was not statistically significant.¹

	<u>0 - 5 Miles From TMI</u>	<u>41 - 55 Miles From TMI</u>
How much do you think scientists know about the effects of radiation?		
A great deal	36%	37%
Some	44%	50%
Very little	19%	11%
Don't know	1%	2%

The difference between the two groups' responses was not statistically significant¹.

¹Utilizing analysis of covariance where age, sex, education, marital status and income have been controlled.

CONCLUSIONS

These findings indicate that the number of people with serious concerns about Three Mile Island dropped substantially from January to October, 1980. First, reductions were noted for both the 0-5 and the 41-55 mile group in: 1) ratings of upset, 2) perceived danger from TMI, and 3) attribution of symptoms to TMI. Second, reductions were greatest in the 0-5 group and, as a result, the two groups became increasingly similar over time in ratings of upset about TMI, perceived danger, reporting of stress-related symptoms and opposition to re-opening the nuclear facility. It should be noted, however, that, in October, 1980, some distress indices were still significantly higher in the 0-5 mile group than in the 41-55 mile group. These indices were perceived threat to safety and attribution of symptoms to TMI.

Attitude and opinion questions which were only included in the October survey showed relatively small differences between respondents close to and far from TMI. However, there were statistically significant differences between these groups in attitudes toward Krypton venting and in belief in some rumors about negative effects of the crisis. It is interesting that, for both types of questions people farther from the plant had more negative views than people close to the plant. There was general agreement among persons both close to and far from TMI that the media had not reported the crisis objectively, that scientists know between "something" and "a great deal" about radiation and that technical experts working under government auspices should have the largest say in how TMI is cleaned up.

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APPENDIX I

FREQUENCY OF RESPONSES CONCERNING INFLUENCE WHICH DIFFERENT GROUPS
SHOULD HAVE IN DECIDING HOW TO CLEAN UP TMI

In deciding how to clean up TMI how much influence should different groups have in determining how it's done? How about...

	<u>0 - 5 Miles From TMI</u>	<u>41 - 55 Miles From TMI</u>
Organized groups of citizens who are either for or against nuclear power.		
A lot	24%	22%
Some	51%	50%
None	21%	23%
Don't know	4%	5%
Energy experts from colleges, universities or other impartial organizations		
A lot	34%	33%
Some	47%	50%
None	14%	13%
Don't know	5%	4%
Decisions voted by the general public		
A lot	39%	38%
Some	45%	43%
None	14%	17%
Don't know	2%	2%
Elected local officials		
A lot	30%	23%
Some	51%	57%
None	16%	18%
Don't know	3%	2%

	<u>0 - 5 Miles From TMI</u>	<u>41 - 55 Miles From TMI</u>
Metropolitan Edison Company		
A lot	29%	36%
Some	46%	43%
None	22%	14%
Don't know	3%	7%
Nuclear Regulatory Commission		
A lot	48%	60%
Some	42%	31%
None	6%	4%
Don't know	4%	5%
Energy experts working for the Pennsylvania Department of Environmental Resources		
A lot	49%	61%
Some	44%	34%
None	3%	3%
Don't know	4%	2%
Elected state or federal officials		
A lot	25%	28%
Some	52%	51%
None	19%	18%
Don't know	4%	3%

Note: Means calculated from these data will differ slightly from those reported in Table 2 since Table 2 means are adjusted using analysis of covariance.

APPENDIX II

FREQUENCY OF RESPONSES CONCERNING BELIEF IN RUMORS ABOUT THREE MILE ISLAND

	<u>0 - 5 Miles From TMI</u>	<u>41 - 55 Miles From TMI</u>
There has been an increase in the number of miscarriages, stillborns, and infant deaths since the TMI accident.		
Definitely	9%	13%
Probably	26%	34%
Don't know	10%	11%
Probably not	40%	32%
Definitely not	15%	10%
There has been an increase in birth defects in the area since TMI.		
Definitely	7%	12%
Probably	24%	33%
Don't know	13%	8%
Probably not	41%	38%
Definitely not	15%	9%
Cancer rates will increase in the area because of TMI.		
Definitely	17%	11%
Probably	37%	45%
Don't know	7%	9%
Probably not	32%	27%
Definitely not	7%	8%
Farm animals in the area have had an increase in health problems since TMI.		
Definitely	16%	14%
Probably	32%	45%
Don't know	7%	9%
Probably not	34%	23%
Definitely not	11%	9%

0 - 5 Miles
From TMI

41 - 55 Miles
From TMI

There has been an increase in general
health problems because of TMI.

Definitely	14%	10%
Probably	29%	45%
Don't know	7%	7%
Probably not	38%	32%
Definitely not	12%	6%

There has been an increase in Mental Health Problems
because of TMI.

Definitely	28%	15%
Probably	30%	50%
Don't know	7%	3%
Probably not	25%	23%
Definitely not	10%	9%

Note: Means calculated from these data will differ slightly from those reported in Table 3 since Table 3 means are adjusted using analysis of covariance.

APPENDIX III

Computation of means, standard deviations, mode and medians for demographic variables for the 0-5 mile group using 12.5% weighting and 11.6% weighting for in-migrants as compared to non-migrants.

	Old wts based on 12.5% <u>mobility</u>	New wts based on 11.6% <u>mobility</u>
<u>Age</u>		
Mean	4.081	4.046
SD	1.167	1.176
Mede	4.000	4.000
Median	4.087	4.046
<u>Sex</u>		
% males	45.4	45.1
% females	54.6	54.9
<u>Education</u>		
Mean	3.313	3.308
SD	1.531	1.521
Mede	3.000	3.000
Median	2.995	2.995
<u>Income</u>		
Mean	3.339	3.330
SD	1.158	1.158
Mede	3.000	3.000
Median	3.033	3.002
<u>Marital Status</u>		
% married	78.4	77.8
% wid/sep/div	13.9	14.0
% unmarried	7.7	8.2

1. Age was scored as follows: Scale 1-6; 1 = Under 18, 2 = 18-24, 3 = 25-34, 4 = 35-49, 5 = 50-64, 6 = 65 or over.
2. Education was scored as follows: Scale 1-7; 1 = Some grade school (1-8), 2 = Some high school (9-11), 3 = Graduated high school, 4 = Technical/vocational school, 5 = Some college, 6 = Graduated college, 7 = Graduate/professional school.
3. Income was scored as follows: Scale = 1-7; 1 = Less than \$5,000, 2 = \$5,000 to \$9,999, 3 = \$10,000 to \$19,999, 4 = \$20,000 to \$29,999, 5 = \$30,000 to \$39,999, 6 = \$40,000 to \$50,000, 7 = Over \$50,000.

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Group

